ORDNANCE

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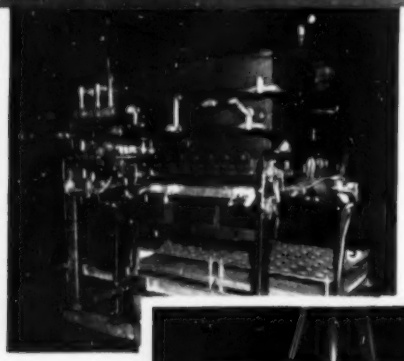
THE LARK—BIRD OF PREY

JANUARY-FEBRUARY 1954

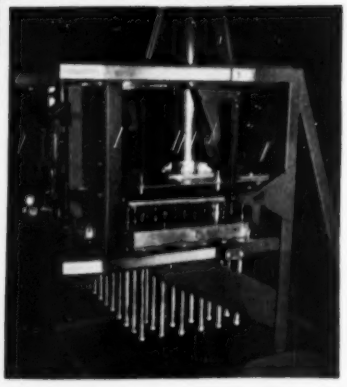
(In two sections: Section I)

MEET "MIGHTY MOUSE"

A four-foot "Mouse" complete with fin tail . . . travels 2,000 miles per hour . . . stowaway on all American jets . . . sudden death to aggressor bombers!



Volumetric Pouring Unit



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Denser - Safer - Cleaner

POURING—2.75's, 57's, 75's, 90's, 105's, 155's, 8-inch, 60 and 81 mortars, mines, etc., etc., at better than a skid a minute—with NO down time!

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ORDNANCE

LAND · SEA · AIR

The Magazine of Scientific and Industrial Preparedness

VOL. XXXVIII JANUARY-FEBRUARY 1954 NO. 202

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New compounds keep military and industrial areas free of undergrowth

DUCTILE IRON GEARS provide *Superior Strength* with *Excellent Resistance to Wear*

Large Gears... such as these Ductile Iron girth gears drive large tube mills in the cement and mining industries. Put into service without heat treatment, they normally provide 92,000 to 100,000 psi ultimate tensile strength, 3 to 5% elongation, and 270-290 BHN on the tooth surface.

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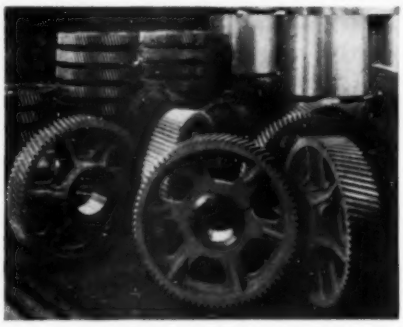
Send us details of your prospective uses, so that we may suggest a source of supply from some 100 authorized foundries now producing Ductile Iron under patent licenses. Request a list of available publications on Ductile Iron . . . mail the coupon now.



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Small Gears . . . also worms . . . exemplify an application of Ductile Iron in the railroad field.

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...what a job it can do for you!

You're looking at a Cat* HT4 Shovel cleaning up around a stockpile in the Kaiser Bauxite Company's Port Kaiser, Jamaica, Plant. This is just one of the many jobs this versatile shovel can do; to mention a few—loading and unloading bulk materials and maintaining roads. What's more, you'll find it can handle these jobs *better*, *faster* and *cheaper* than any competitive unit!

That's saying a lot, but on-the-job records show the HT4 backs it up with performance. For one thing, it's a *fast* worker. The Caterpillar-built hydraulic system lets the operator raise and dump at the same time, and features an automatic kick-out. Notice how high he sits, with a clear view of the bucket and job. A compact machine, the HT4 can produce in tight spots where bigger equipment can't. Weight, power and bucket capacity are *balanced* for maximum work capacity.

Another factor in the HT4's big production: *stamina*. This rugged rig can really take a beating. Here are a few examples of its extra-strong construction. Frame and mounting and lift arms are all welded and cross-braced to prevent weaving or sidesway. The bucket has a heat-treated, high-carbon steel cutting edge for longer wear. The hydraulic system is enclosed, safe from dirt and grit. All these and other important details add up to a long, useful working life with a minimum of down time.

Have you work in mind for the HT4? Your Caterpillar Dealer will be glad to show you what it can do on your job. Name the place and date—he'll demonstrate!

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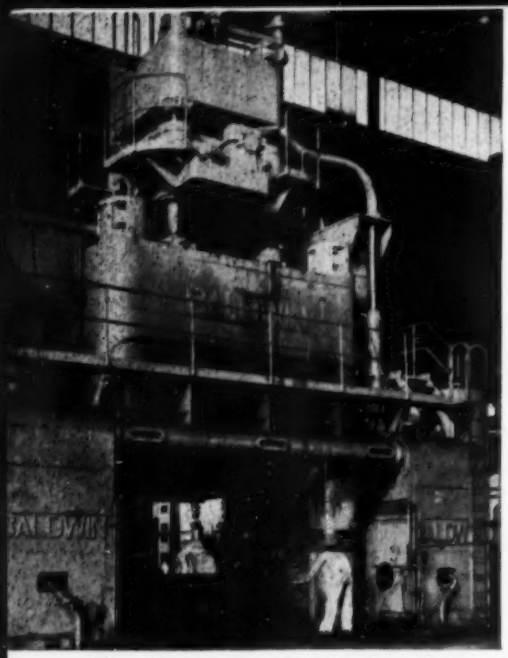
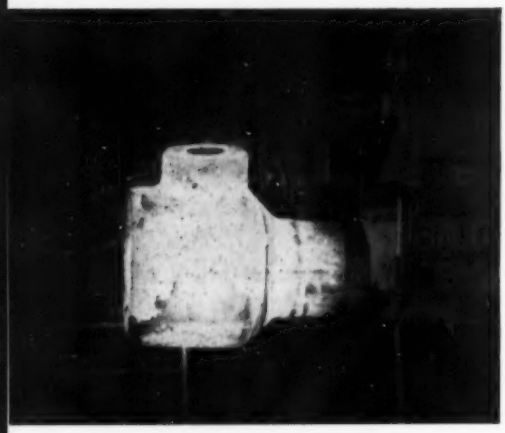
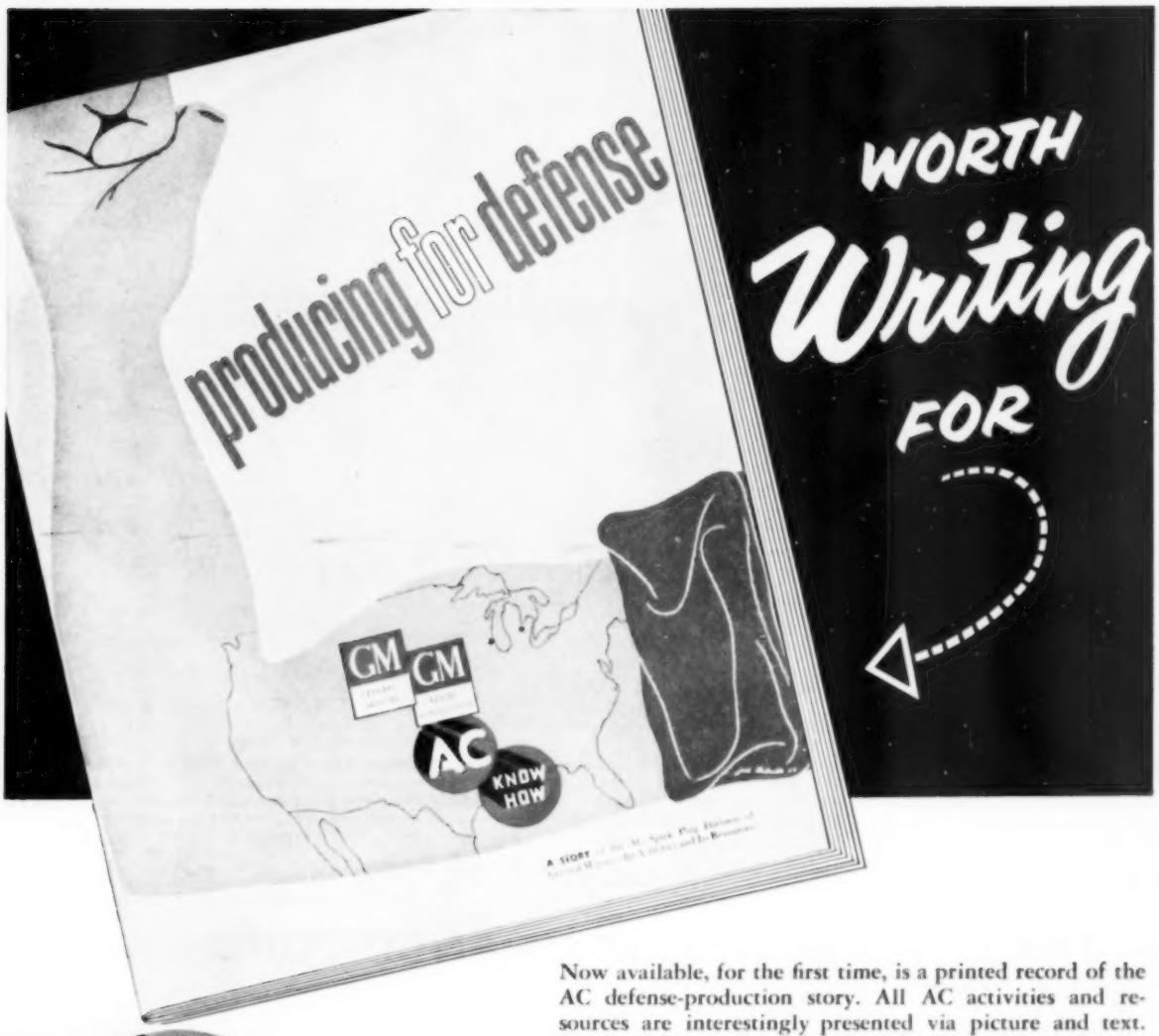


The horizontal split die has just opened after forging a throttle valve body.



The throttle valve body, having been pierced by the two side acting rams and the down acting ram, is removed from the die set.

The manipulator is placing the 3,590 pound forging to one side for further processing.



Now available, for the first time, is a printed record of the AC defense-production story. All AC activities and resources are interestingly presented via picture and text. Through it you can become quickly acquainted with the physical facilities, manpower, training programs and production achievements of this Division of General Motors. Get your copy soon and discover how the "know-how" and experience AC has accumulated in the past can be projected into the future . . . perhaps in your behalf!

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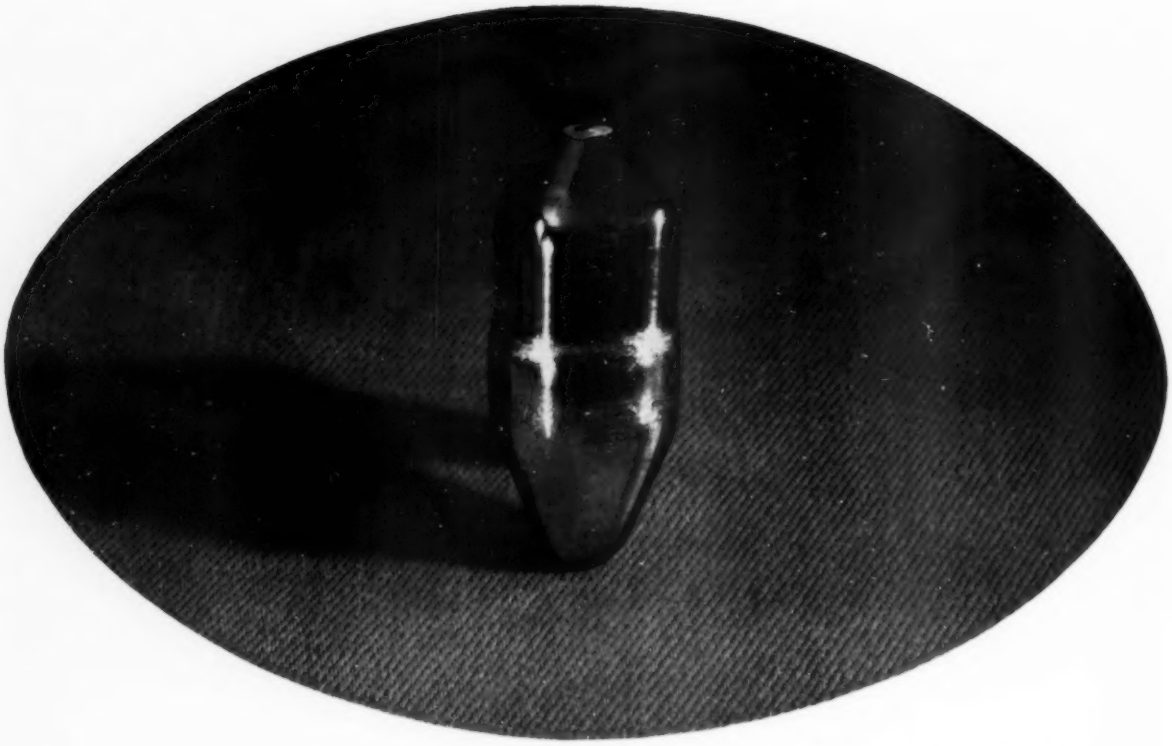


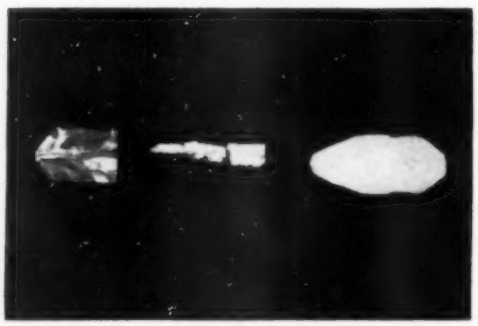
Germanium crystal grown at Bell Telephone Laboratories (life size). It is sliced into hundreds of minute pieces to make *Transistors*. Transistor action depends on the flow of positive current-carriers as well as electrons, which are negative. Arsenic —a few parts per 100,000,000—added to germanium produces prescribed excess of electrons. With gallium added, positive carriers predominate. Latest junction type *Transistor* uses both kinds of germanium in the form of a sandwich.

THEY GREW IT FOR TRANSISTORS

Heart of a ***Transistor*** – Bell Telephone Laboratories' new pea-size amplifier – is a tiny piece of germanium. If ***Transistors*** are to do their many jobs well, this germanium must be of virtually perfect crystalline structure and uniform chemical composition. But it doesn't come that way in nature.

So—Bell scientists devised a new way to *grow* the kind of crystals they need, from a melt made of the natural product. By adding tiny amounts of special alloying substances to the melt, they produce germanium that is precisely tailored for specific uses in the telephone system.

This original technique is another example of the way Bell Laboratories makes basic discoveries – in this case the ***Transistor*** itself – and then follows up with practical ways to make them work for better telephone service.



Section of natural germanium, left, shows varying crystal structure. At right is sectioned single crystal grown at Bell Laboratories.

IMPROVING TELEPHONE SERVICE FOR AMERICA PROVIDES CAREERS FOR CREATIVE MEN IN SCIENTIFIC AND TECHNICAL FIELDS

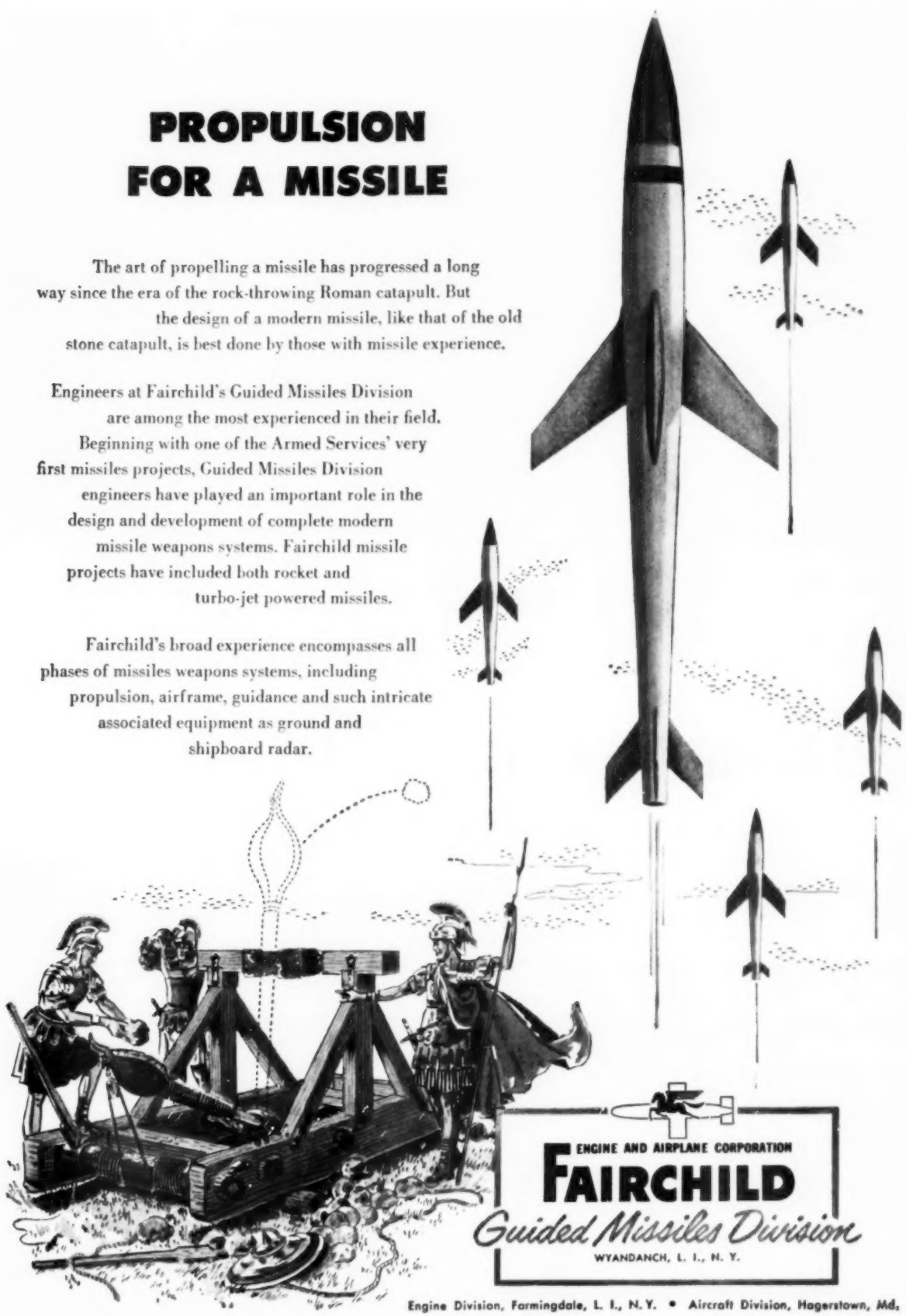
BELL TELEPHONE LABORATORIES

PROPULSION FOR A MISSILE

The art of propelling a missile has progressed a long way since the era of the rock-throwing Roman catapult. But the design of a modern missile, like that of the old stone catapult, is best done by those with missile experience.

Engineers at Fairchild's Guided Missiles Division are among the most experienced in their field. Beginning with one of the Armed Services' very first missiles projects, Guided Missiles Division engineers have played an important role in the design and development of complete modern missile weapons systems. Fairchild missile projects have included both rocket and turbo-jet powered missiles.

Fairchild's broad experience encompasses all phases of missiles weapons systems, including propulsion, airframe, guidance and such intricate associated equipment as ground and shipboard radar.



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WYANDANCH, L. I., N. Y.

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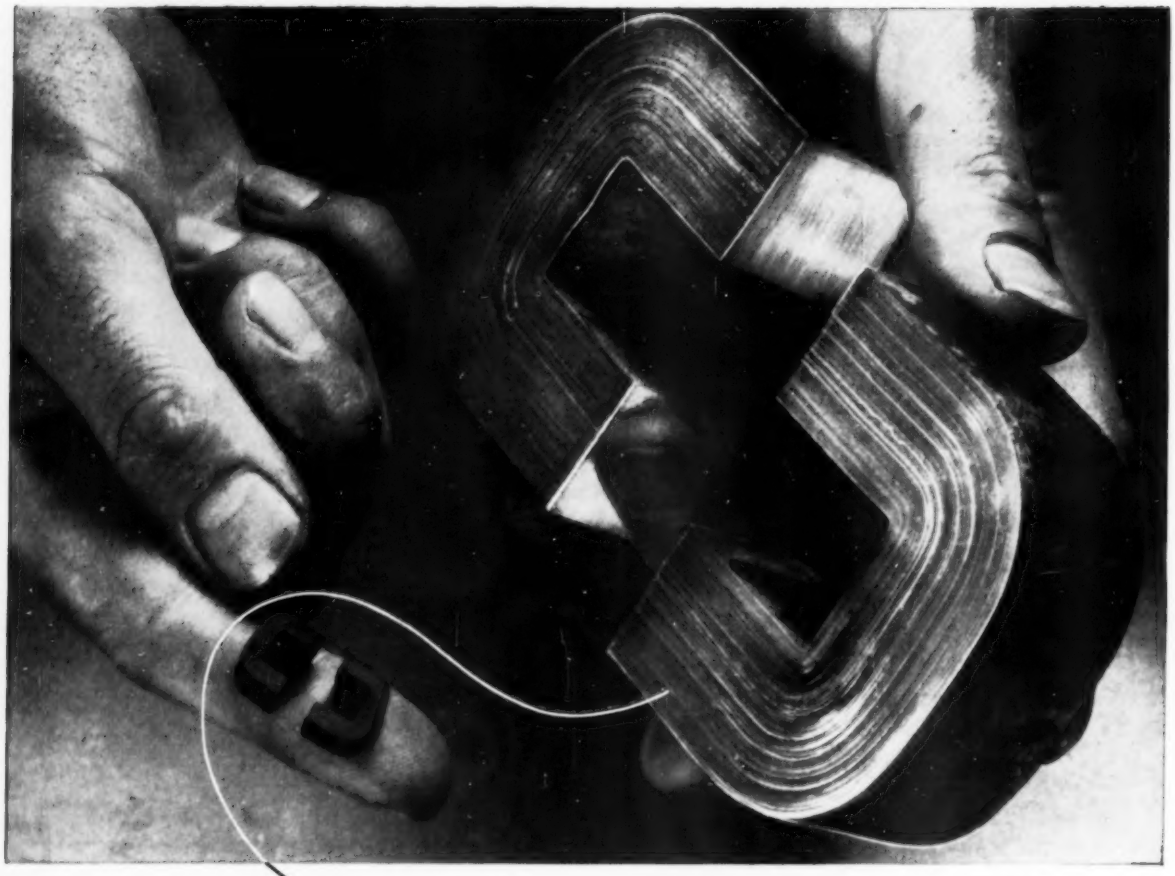

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ALODIZING IS EASY AND EFFECTIVE

The Alodizing process is a chemical one and does not require electrolytic techniques or equipment. Alodizing is simple, fool-proof, low in cost, and requires a minimum of equipment. Essentially, the process consists of the following easily controlled operations or steps:

1. Cleaning the work.
2. Rinsing the cleaned aluminum surfaces.
3. Coating with "Alodine."
4. Rinsing with clean water.
5. Rinsing with warm "Deoxylyte" (acidulated rinse).
6. Drying.

AFTER TREATMENTS: Alodized aluminum provides an ideal bonding surface for paint, wax, adhesive, or other organic finishes. These should be applied in accordance with the manufacturer's directions. Unpainted or exposed areas will be protected by the tough, durable "Alodine" skin.

"ALODINE" MEETS SERVICE SPECIFICATIONS

"Alodine" applied by immersion or spray complies with the rigid performance requirements of both industrial and Government specifications. The following is a list of Service Specifications which "Alodine" meets.

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MIL-S-5002	16E4 (SHIPS)
AN-E-19	AN-C-170 (See MIL-C-5541)
AN-F-20	U.S.A. 72-53 (See AN-F-20)

Drawing courtesy of Piasecki Helicopter Corporation, Morton, Pennsylvania

THE H-21 Piasecki Tandem Helicopter—the "Work Horse"—is ideally suited for rescue work in areas inaccessible by other means, and in all kinds of rough weather.

For durable paint adhesion and high corrosion-resistance aluminum parts of the "Work Horse" are Alodized. The "Alodine" protective coating chemical bonds paint, extends paint life, and protects unpainted aluminum.

Because of its economy, effectiveness, and ease of application, the Alodizing process is finding wide-spread use in the aircraft field and in other industries fabricating products of aluminum.

Alodized aluminum meets the requirements of Military Specification MIL-C-5541. Write or call for coating and process data on "Alodine".

"Alodine" Trade Mark Reg. U. S. Pat. Off.

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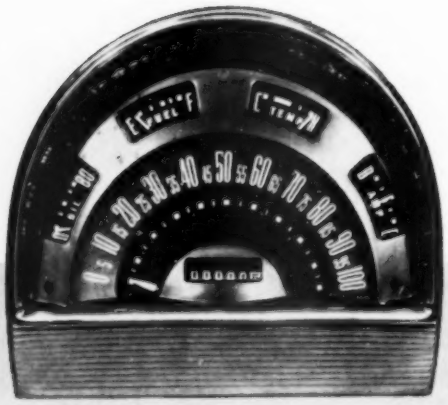

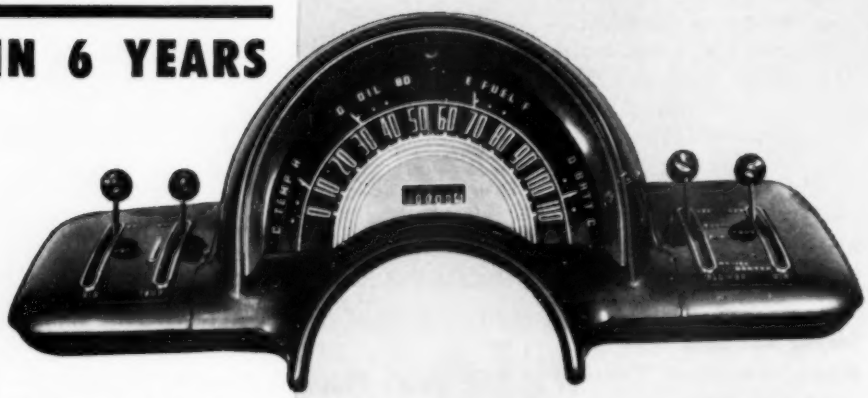

Early in 1948 King-Seeley completed the development and testing of a new speedometer design using a Cunife magnet. King-Seeley adopted this magnet material because of its inherent stability and imperviousness to shock, vibration, temperature variations and stray magnetic fields.

The general acceptance of this new design has been more than gratifying. Production has increased 160 per cent since its adoption and three new accounts have been added to the list of original equipment users.

This is the automotive industry's recognition of an instrument that has won the car owner's complete approval.

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ANN ARBOR, MICHIGAN
Plants at ANN ARBOR, SCIO and YPSILANTI

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an outstanding achievement

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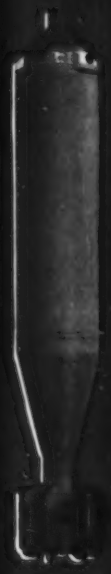
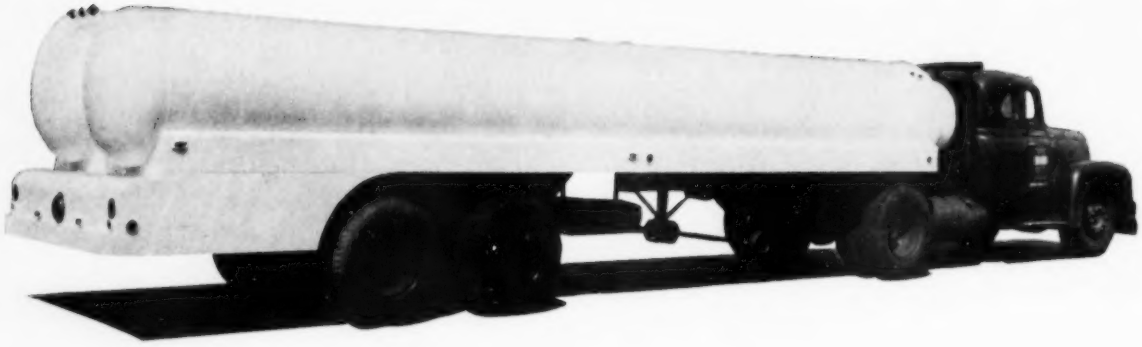
The coordinated production of KWIKSET Defense Products and KWIKSET'S subsidiary, West Coast Loading Corporation, has made possible the manufacturing and loading of over 1,500,000 60-mm mortar illuminating shells for the defense of our nation.



Kwikset Defense Products, Anaheim, California

Another Example of Beaird Manufacturing Skill



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We are already well known in the LP-Gas and anhydrous ammonia fertilizer fields as being pioneers in developing special equipment required for these liquefied gases. Now we have added to that line a trailer transport. Developed by Beaird engineers, the transport incorporates the many advanced manufacturing techniques for which other Beaird products are known.

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- **N-A-X 9100** series—alloy steels for carburizing and heat treated parts.

With these three N-A-X ALLOY STEELS, we offer time proven products to economically serve you.

N-A-X HIGH-TENSILE is 50% stronger than mild carbon steel with high notch toughness. Has excellent cold forming and welding properties and greater resistance to atmospheric corrosion and abrasion.

N-A-X AC 9115—a steel easily fabricated and welded by any method, maintains high strength at elevated temperatures up to 1000°F. When protected against high temperature oxidation by proper coatings, it is a worthy alternate for the higher-alloy stainless type steels for this application.

N-A-X 9100 series—a series of alloy steels with the alloying elements constant within an established range, with carbon varied to suit the hardenability and hardness desired. An outstanding carburizing steel.

GREAT LAKES STEEL CORPORATION

N-A-X Alloy Division — Ecorse, Detroit 29, Mich.

NATIONAL STEEL CORPORATION

PUMPS

for ORDNANCE

FLUID POWER PUMPS

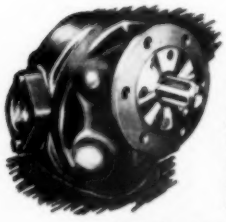
Hydraulic power for fire-control; elevating, traversing and loading guns; operation of turrets, steering mechanism and drive wheels of vehicles; materials handling; production and metal forming equipment; raising and lowering ramps, platforms, signal masts, derricks, etc.; powering controls and operational gear on amphibious craft, vehicles and aircraft.

LIQUID HANDLING PUMPS

An exceptionally broad range of types, sizes and special constructions to handle virtually "any substance that will flow through a pipe" including: gasoline, acids, sludges, slurries, asphalt, fuel oil and other viscous and non-viscous fluids.

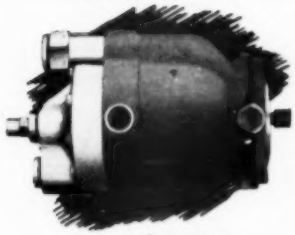
VACUUM PUMPS

High vacuum pumps for laboratory, electronic, atomic research, chemical processing, vacuum refining of metals, dehydration, vacuum drying, refrigeration and de-aerating.



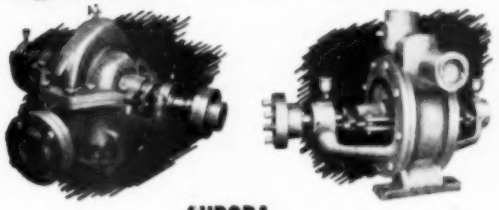
HYDRECO GEAR TYPE PUMPS

Reversible and non-reversible. Gear type pumps in exclusive FOUR-BOLT design . . . capacities from .5 to 130 gpm and operating pressures to 1500 psi . . . flange or foot mounted . . . furnished with keyed shaft with spline shafts optional. Also dual and tandem models.



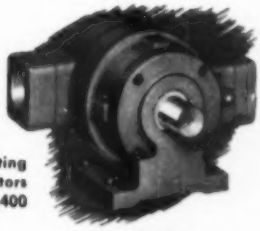
STRATOPOWER PISTON TYPE PUMPS

Axial reciprocating piston type . . . constant or variable delivery with capacities of .25 to 10 gpm at nominal speeds of 1500 rpm with maximum of 4500 rpm . . . working pressures to 3000 psi . . . direct engine and individual electric motor driven models.



AURORA CENTRIFUGAL & TURBINE PUMPS

Deep well, sump, drainage and condensation return units, household water systems. Industrial low and high pressure liquid handling pumps. Direct motor and countershaft driven horizontal and vertical models. Capacities 3 to 7500 gpm.

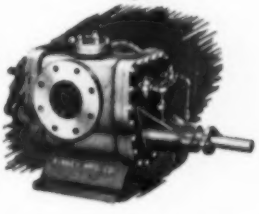


DUDCO DUAL VANE TYPE PUMPS

DUDCO Pumps provide a broad range of sizes with capacities to 120 gpm and pressures to 2000 psi. Also available in dual units operating from a single drive. Hydraulic motors with starting torque outputs to 14,400 lb. in.

KINNEY VACUUM PUMPS

Single stage models to produce absolute pressure readings of 10 microns (.01 mm Hg.) . . . compound pumps producing readings of .2 microns (.0002 mm Hg.) or better. These Kinney High Vacuum Pumps are available in sizes for laboratory as well as high production use.



KINNEY LIQUID HANDLING PUMPS

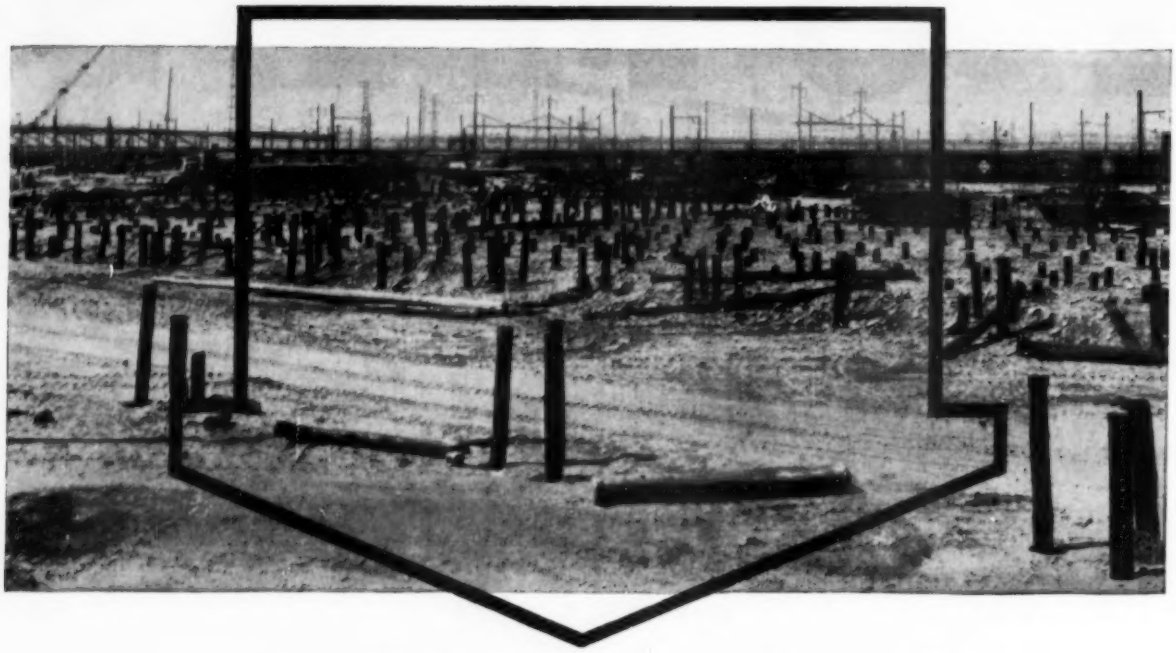
A complete range of sizes in Rotating Plunger and Herringbone Gear Pumps to handle light or heavy liquids, from gasoline to asphalts. Available in plain or steam jacketed models.

THE NEW YORK AIR BRAKE COMPANY
230 PARK AVENUE • NEW YORK 17, N. Y.

THE NEW YORK AIR BRAKE COMPANY
230 Park Ave., Dept. O, New York 17, N. Y.
Gentlemen: Kindly send me additional information on:
Hydraulic Pumps ☐ 1000 psi ☐ 2000 psi ☐ 3000 psi Liquid Handling Pumps ☐ Vacuum Pumps ☐

Name .....
Address .....
City ..... State .....

Pressure-Creosoted Piles, Driven Upside-Down,



Save Half a Million Dollars in Warehouse Construction

DRIVING pressure-creosoted timber piles with the big end down saved half a million dollars for Safeway Stores, Inc., on the construction of a warehouse in Kearny, New Jersey, by the Turner Construction Company. Alexander D. Crosett & Associates were the architects. A readily reachable stratum of sand, upon which the engineers intended to support the piles, was not sufficiently thick or dense to prevent the 8-inch-tip piles from punching through. Piles long enough to reach a lower stratum adequate to support the structure, would have been difficult and extremely costly.

To meet this unusual situation, the foundation consultants on the project, Moran, Proctor, Mueser and Rutledge, recommended that the timber piles be driven with the large end down. 8-inch-tip, 12-inch-butt pressure-creosoted piles were driven at about 6-foot center-to-center to support the building.

This butt-end down system made the installation of extremely long piles unnecessary, and resulted in very large savings. In addition, a considerable amount of valuable time was saved—time which would have been consumed in driving long piles. The driven piles, over 7500 of them, were remarkably firm laterally, withstanding individual load tests of twice their designed intensity, i.e., 25 tons.

Koppers Pressure-Creosoted Foundation Piles support all types of industrial and commercial structures —provide lasting protection against fungi, termites, and acids in the soil.

For information on price and delivery, write:

KOPPERS COMPANY, INC.
Wood Preserving Division, Pittsburgh 19, Pennsylvania

KOPPERS

PRESSURE-TREATED WOOD

Machinery for Rebuilding the Nation's Roads...

...is part of the "Blaw-Knox Job" for Industry

The need is for more highways, better highways, proper rebuilding of the over-crowded highways now in use. Blaw-Knox machinery for building concrete and black-top highways and airfields . . . its pavers, batching plants, concrete spreaders and finishers, forms and other products . . . are moneymakers for contractors everywhere.

The "Blaw-Knox Job" for industry is that of boosting production, performance and profits. Blaw-Knox also gives a lift to such industries as—Ferrous and Non-Ferrous Metals, Radio and TV, Gas and Petroleum, Chemical and Food Processing, Plastics, and Public Utilities.

The right-hand column indicates the scope of Blaw-Knox. Full information about any product or service will gladly be sent on request.

MEMBERS OF THE BLAW-KNOX "FAMILY" AND SOME OF THEIR PRODUCTS

Blaw-Knox Equipment Division
Blawnox, Pa.
- Concrete Road Paving Machinery
- Clamshell Buckets
- Contractors Equipment
- Gas Cleaning Equipment
- Open Steel Flooring
- Radio, TV and Transmission Towers
- Steel Forms for Concrete Construction
- Chemical and Process Equipment
- Water Cooled Equipment for High Temperature Furnaces

Buffalo-Yak Equipment Division
Buffalo 11, New York and Mora, Minn.
- Machinery for the Chemical and Food Processing Industries
- Specialized Machinery for the Dairy Industry

Chemical Plants Division
Pittsburgh 30, Pa.
- Complete Chemical, Petrochemical, Industrial and Petroleum Plants

Foote Construction Equipment Division
Nunda, New York
- Black Top Road Pavers
- Concrete Road Pavers

Lewis Machinery Division
Groveton, Pa.
- Rolling Mills and Auxiliary Machinery for Rolling Ferrous and Non-Ferrous Metals

National Alloy Division
Blawnox, Pa.
- Alloy Steel Castings for Extreme Temperatures, Abrasion and Corrosion Resistance

Power Piping and Sprinkler Division
Pittsburgh 33, Pa.
- Prefabricated Piping Systems for High Pressures and Temperatures. Pipe Hangers
- Automatic Sprinkler Systems for Fire Protection

Rolls Division
(Pittsburgh and Lewis Rolls)
Pittsburgh 1, Pa.
- Rolls for Steel and Non-Ferrous Rolling Mills

Union Steel Castings Division
Pittsburgh 1, Pa.
- Heavy Steel Castings

BLAW-KNOX

BRANCH OFFICES:

Birmingham 3, Alabama
Chicago 3, Illinois
Philadelphia 3, Pennsylvania
New York 17, New York
San Francisco 5, California
Washington 5, D. C.
Tulsa 1, Oklahoma
Export—New York 17, New York

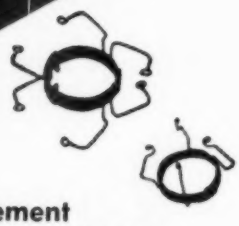
© 1953 Blaw-Knox Co.

BLAW-KNOX
Company
FARMERS BANK BUILDING
PITTSBURGH 22, PA.

Nothing makes

Ordnance Components

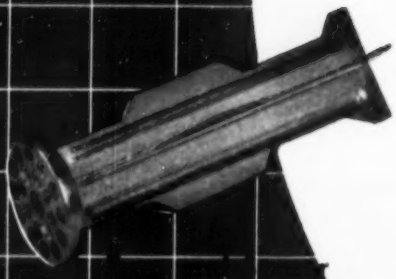
like Experience



Increment Holders

Precision Deep-Drawings

Arming Wires
Safety Clips



Experience in the successful design and production of a wide variety of ordnance components is a priceless asset to the manufacturer.

Eastern Tool & Mfg. Co. is experienced in the design and production of many types and sizes of ordnance components, some of which are illustrated. We welcome inquiries from ordnance contractors interested in obtaining wire forms, metal stampings and precision deep-drawings.

Write for Booklet No. 100.

Eastern Tool & Mfg. Co.
Belleville 9, New Jersey

insure faster starting... peak engine operation without lengthy warm-up!

South Wind's

Model 939-A24

COOLANT HEATER

delivers 15,000 btu/hr. to coolant!

Here is a coolant heater that gives you all the advantages of "inside-out" heating, that offers rapid engine and battery warm-up, that will maintain normal engine temperature on a moving vehicle. These functions insure faster starts, less engine wear, and longer battery life. Here is a coolant heater that is:

COMPACT—approximately 6 inches in diameter, and 15¼ inches long.

POWERFUL—delivers 15,000 BTU/hr. to coolant, with approximately 6,000 BTU/hr. of hot air available for other uses.

SIMPLE—coolant intake and outlet on heater connect directly to cooling system. Coolant may be circulated either by thermo-syphon action, or by electric water pump.

JUST CHECK THESE MAJOR FEATURES!

1. Will maintain a specified coolant temperature by cycling automatically between high and low heat.

2. Can provide intermittent or constant heat to battery.

3. Will operate satisfactorily on a moving vehicle.

4. Will withstand exhaust restriction equivalent to more than 125 feet of 1½ inch exhaust pipe.

5. May be mounted horizontally or vertically.

6. Easy installation as a result of package design incorporating self-contained fuel valve, cycling switch, and overheat switch.

7. Specially designed combustion chamber to prevent formation of carbon on water jacket walls.

8. Combustion blower fan powered by reliable ball bearing motor.

9. Unit radio suppressed to latest requirements of MIL-S-10379.

10. Unique design allows for low production cost.

11. Service parts interchangeable with those of South Wind Model 978 personnel heater.

Do You Have a Heating Problem? Write today for the experienced counsel of South Wind field engineers about *any* problem in pre-heating. The wide range of South Wind Heaters includes 15,000 – 20,000 – 30,000 – 50,000 – 60,000 – 100,000 – 200,000 – 600,000 – and 700,000 BTU/hr. capacities. Write South Wind Division, Stewart-Warner Corporation, Indianapolis 7, Indiana.

South Wind

A PRODUCT OF SW STEWART WARNER

PERSONNEL HEATING
ENGINE AND EQUIPMENT PRE-HEATING
WINDSHIELD DEFROSTING

TRIBUTES TO SOME PEOPLE WE ALL LIKE:

WAGING PEACE IS

This is an especial salute for the men and women in the "enlisted ranks" of Uncle Sam's armed forces. Whether serving at home or overseas, these people have elected to put 10, or 20, or 30 years of their lives against the essential job of holding a hard core of trained personnel ready to man the implements of national defense.

As a nation, we live a long cry from that day in April, 1775, when a handful of rugged Colonists lifted their muskets from their mantel-pieces and went to meet the enemy at Concord.

Amazing as this country's ability has been to turn its people and its production swiftly from needs of peace to those of emergency, it is also grimly clear that a man cannot come home from the office and

DEADLY ACRID FLAMES spurt from a white phosphorus grenade as Corporal Henry W. Roark signals his flame thrower into action for the final assault on an "enemy" pillbox. Corporal Roark, fire team leader of a rifle squad at Marine Corps Schools, Quantico, Va., will see no enemy during this problem, is prepared for the real thing in time of war.

by EDGAR A. GUEST

They are the strength of freedom's wall,
The men and women, one and all,
Who serve by land and sea and sky
That liberty shall never die;
Sworn all to keep our country free
From every threat of tyranny.

Army, and Navy and Marine!
All that life holds for us they mean.
Those Air Force lads who hasten by
Are valiant guardians of the sky,
And those who stand at lonely posts
Are brave defenders of our coasts.

G.I.'s or Gobs or Leather Necks!
The humblest boy who swabs the decks,
The Wacs and Waves, at work or ease,
For us are freedom's guarantees,
All are our stalwart, steadfast friends.
On them our way of life depends.

Brave youth! Draftee or Volunteer
It matters not. When foes appear
Who would destroy our glorious land,
Behind the wall you build we stand,
Assured that freedom, by your worth,
Shall never perish from the earth.

If you would like a reprint of this poem, suitable for framing, write Chrysler Corp., Dept. RS3, 341 Massachusetts Ave., Detroit, Mich.

Copyright 1953 Chrysler Corporation

40 MM TWIN MOUNT SCOWLS DEFIANTLY from the after-island gun tub of the U.S.S. Tarawa as AB 3/c John Robertson mans the No. 1 loader during general quarters. John enlisted in the Navy in 1950, spent 6 months in special schools after boot camp. Unmarried, John plans to see the world as he furthers his own career in the Navy.

This advertisement appears in **LIFE** *December 7, 1953*

ENLISTED WOMEN of the Army, Navy, Air Force and Marines are represented by this color guard quartet. All voluntary enlistments, these four typify the loyalty to country of 46,000 women currently serving in the armed forces.

THE NATION'S ONLY NAVY from 1790 to 1798, the U.S. Coast Guard is still making history in pioneering new developments of sea rescue and coastal defense. Here, a helicopter, unaided, dips a lone crash survivor from the sea. Under the Navy in war, the Coast Guard is now controlled by the Treasury Dept.

THEIR CAREER . . .

take down a 75 mm howitzer, or a 46-ton tank, or a jet plane, or a snorkel-breathing submarine, or a sky-sweeping radarscope, or a 16-inch gunned battlewagon, and just step forth to meet the foe.

Highly technical modern fighting equipment is both vital and hard to handle. The people who man and serve these devices must be trained long and hard and well. In times of peace, especially, there will not be much glory for the folks who take on this job.

But, peace or war, there can be only gratitude in the hearts of their civilian neighbors for the diligence with which they dedicate the good years of their lives to these jobs.

Yes, the people of Chrysler Corporation are proud to tip their hats deep to those people in the enlisted ranks of the U.S. Army, Navy, Air Force, Marines, and Coast Guard.

Without them standing by, armed might would not be very mighty.

This message about people we all like is presented by your PLYMOUTH—DODGE—DE SOTO—CHRYSLER—DODGE "JOB-RATED" TRUCK dealers, and

CHRYSLER CORPORATION

Enjoy "Medallion Theatre" . . . dramatic entertainment for all the family . . . every week. CBS-TV. See local paper for time and station.

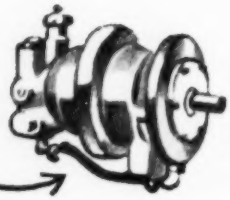
PHOTOS BY PHILIPPE HALSMAN

THIRSTY WING TANK rapidly consumes 230 gallons as S/Sgt. Robert Dieffenderfer refuels his T-33 jet trainer at the end of a routine flight. Attached to the 5th Fighter Interceptor Squadron at McGuire Air Force Base, N.J., Crew Chief Dieffenderfer, a skilled technician at only 26, has sole responsibility for maintenance and upkeep of $100,000 plane.

RUGGED TRAINING for rugged soldiers is all part of Army life, as M/Sgt. James Matthews shows two recruits the ropes at Ft. Dix, N. J. Only 29, Matthews is top sergeant over 234 men in the 60th infantry regiment. A typical career man, Matthews is married, has two children, plans to "try for 20 years, then buy a place at the shore and just fish."

FROM *the Bundy Sketchbook*
TO *jog a designer's imagination*

HIGH PRESSURE OIL PUMP LINES



FLINT HOLDER FOR CIGARETTE LIGHTER

THERMOSTAT FOR DEEP FAT FRYER

ADJUSTABLE CLOTHES RACK FRAME

REMARKS Baffled by a brand-new tubing headache? It may be old stuff to us. Our engineers have licked hundreds of tubing problems; may help lick yours. Why not let us put Bundyweld, plus our specialized engineering skills and unmatched fabrication facilities to work on your problem.

WRITE to us for catalog or for specific information on your problem.

BUNDY TUBING COMPANY
DETROIT 14, MICH.

WHY BUNDYWELD IS BETTER TUBING

Bundyweld starts as a single strip of copper-coated steel. Then it's . . .

continuously rolled twice around laterally into a tube of uniform thickness,

and passed through a furnace. Copper coating fuses with steel. Result . . .

Bundyweld, double-walled and brazed through 360° of wall contact.

BUNDYWELD TUBING®

DOUBLE-WALLED FROM A SINGLE STRIP

Leakproof
High thermal conductivity
High bursting point
High endurance limit
Extra-strong
Shock-resistant
Ductile

Lightweight
Machines easily
Takes plastic coating
Takes plating
Bright and clean
No inside bead
Uniform I.D., O.D.

Bundy Tubing Distributors and Representatives: ***Bridgeport, Conn.:*** Korhumel Steel & Aluminum Co., 117 E. Washington St. • ***Cambridge 42, Mass.:*** Austin-Hastings Co., Inc., 226 Binney St. ***Chattanooga 2, Tenn.:*** Peirson-Deakins Co., 823-824 Chattanooga Bank Bldg. • ***Chicago 32, Ill.:*** Lapham-Hickey Co., 3333 W. 47th Place • ***Elizabeth, New Jersey:*** A. B. Murray Co., Inc., Post Office Box 476 • ***Los Angeles 58, Calif.,*** Tubesales, 5400 Alcoa Ave., • ***Philadelphia 3, Penn.:*** Rutan & Co., 1717 Sansom St. • ***San Francisco 10, Calif.:*** Pacific Metals Co., Ltd., 3100 19th St. • ***Seattle 4, Wash.:*** Eagle Metals Co., 4755 First Ave., South • ***Toronto 5, Ontario, Canada:*** Alloy Metal Sales, Ltd., 181 Fleet St., N.

Bundyweld nickel and Monel tubing are sold by distributors of nickel and nickel alloys in principal cities.

HERE'S MORE POWER TO YOU

CONTINENTAL RED SEAL

TRANSPORTATION GASOLINE ENGINES

Model	Cyl.	Bore	Stroke	Displ.	Bare Engine H.P.
N4062	4	2½	3½	62	26 @ 3400 RPM
Y4069	4	2½	3½	69	28 @ 3400 RPM
Y4091	4	2⅝	3½	91	36 @ 3400 RPM
F4124	4	3	4½	124	47 @ 3200 RPM
F4140	4	3⅛	4½	140	52 @ 3200 RPM
F4162	4	3⅜	4½	162	58 @ 3200 RPM
F6186	6	3	4½	186	77 @ 3500 RPM
F6209	6	3⅛	4½	209	90 @ 3500 RPM
F6226	6	3⅛	4½	226	99 @ 3500 RPM
M6271	6	3⅛	4½	271	97 @ 3000 RPM
M6290	6	3⅜	4½	290	108 @ 3000 RPM
M6330	6	4	4½	330	125 @ 3000 RPM
K6271	6	3⅛	4½	271	115 @ 3200 RPM
K6290	6	3⅜	4½	290	123 @ 3200 RPM
K6330	6	4	4½	330	145 @ 3200 RPM
B6371	6	4⅛	4½	371	124 @ 3000 RPM
B6427	6	4⅛	4⅞	427	142 @ 3000 RPM
T6371	6	4⅛	4½	371	144 @ 3000 RPM
T6427	6	4⅛	4⅞	427	170 @ 3000 RPM
U8501	6	4½	5¼	501	178 @ 2600 RPM
R8513	6	4½	5⅓	513	180 @ 2800 RPM
R8572	6	4⅝	5⅓	572	200 @ 2800 RPM
R8602	6	4⅞	5⅓	602	212 @ 2800 RPM
S8749	6	5⅛	5½	749	250 @ 2800 RPM
S8820	6	5⅛	5½	820	275 @ 2800 RPM

TRANSPORTATION DIESEL ENGINES

Model	Cyl.	Bore	Stroke	Displ.	Bare Engine H.P.
TD6427	6	4⅛	4⅞	427	116 @ 2400 RPM
RD6572	6	4⅝	5⅓	572	162 @ 2400 RPM
SD6802	6	5⅛	5½	802	217 @ 2200 RPM

. . . AT LOWER TON-MILE COST

When you buy a vehicle powered by Continental Red Seal engine, you "plug in on" specialized knowledge that goes back a long, long time . . . benefit from engineering features, and advances in production technique, evolved over a period of more than 50 years. Red Seal dependability, economy and stamina have long been building prestige for the industry's quality leaders. Continental-powered transport units will give you more and better power—at lower ton-mile cost.

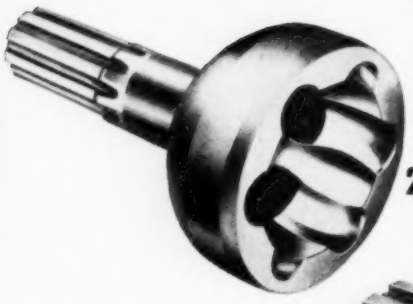
PARTS AND SERVICE EVERYWHERE

1819 BROADWAY, NEW YORK 23, NEW YORK • 3817 S. SANTA FE AVE., LOS ANGELES 58, CALIF.
6218 CEDAR SPRINGS ROAD, DALLAS 9, TEXAS • 910 S. BOSTON ST., ROOM 1008, TULSA, OKLA.
1252 OAKLEIGH DRIVE, EAST POINT (ATLANTA) GA.

Continental Motors Corporation
MUSKEGON, MICHIGAN

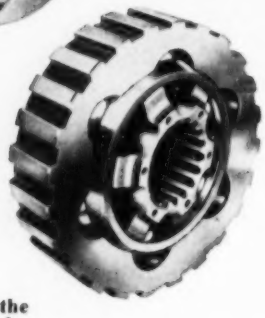
CONTINENTAL MOTORS · Powerful as the Nation · AMERICA'S STANDARD

YOU GET ALL 5
WITH THESE 2



1 CONSTANT VELOCITY
Transmits rotary motion from one shaft to another—uniformly, smoothly. Hardened steel balls roll in grooved raceways, providing true rolling action.

2 HIGHEST ANGULARITY
Up to 35°! No variation in relative angular velocity is possible.



3 HIGHEST CAPACITY
For size and weight, the most rugged performer you can select.

4 COMPACTNESS
Designed to work in the closest quarters possible. Compare dimensions before you specify any joint.

5 AND—LONG LIFE!
Constant Velocity builds in durability.

THE UNIVERSAL FAVORITE:
RZEPPA Constant Velocity UNIVERSAL JOINTS

Especially ideal for 4-wheel drives and many varied types of drive line applications . . . it eliminates the old problem of speed fluctuations in the driven shaft.

Before specifying any universal joint, compare ALL the factors that count. You'll find the very best costs a lot less than you think. For the complete Rzeppa performance and engineering story:

SEND FOR THIS CATALOG NOW→

JOINT DIVISION, THE GEAR GRINDING MACHINE CO.
3907 Christopher • Detroit 11

ATOMIC ENERGY

BONUS SCHEDULES EXTENDED

The Atomic Energy Commission has extended the expiration date of the guaranteed minimum price schedule for uranium ores of the Colorado Plateau area and also has extended the time during which initial production of uranium ore from new domestic mines will be eligible for bonus payments.

The actions were taken for the purpose of continuing the Commission's program of encouraging the production of uranium from domestic sources.

The Commission's Domestic Uranium Program Circular 5, Revised, has been extended to cover the period through March 31, 1962, from its previous expiration date of March 31, 1958. This circular, which went into effect on March 1, 1951, provides guaranteed minimum base prices for the uranium-oxide content of carnotite-type and roscoelite-type ores of the Colorado Plateau area.

The price schedule ranges from $1.50 to $3.50 per pound of uranium-oxide content, depending upon the grade of the ore, together with certain allowances and premiums.

Domestic Uranium Program Circular 6, which established a bonus for initial and certain other production of uranium ores from domestic mines delivered under its terms between March 1, 1951, and February 28, 1954, now has been extended through February 28, 1957.

For eligible new mining properties, bonus payments are made on each pound of uranium oxide in acceptable ores delivered to qualified mills or Commission buying stations up to and including the first 10,000 pounds of uranium oxide.

For eligible mining properties which produced less than 10,000 pounds of uranium oxide during the period from April 9, 1948, to March 1, 1951, bonus payments are made on the difference between 10,000 pounds of uranium oxide and the number of pounds sold between April 9, 1948, and March 1, 1951.

Bonus payments range from $1.50 to $3.50 per pound of uranium oxide in acceptable ores produced from eligible mining properties, depending on the grade of the ore. Thus, the maximum bonus which may be obtained from production of new mines ranges from $15,000 to $35,000, depending upon the grade of ore delivered.

Copies of Circular 5, Revised, and Circular 6 may be obtained from the Commission's Grand Junction Operations Office, Post Office Box 270, Grand Junction,

Accurate Field Testing of X-Band Radars

WITH MICROLINE* TEST SET AND RANGE CALIBRATOR

Included in Sperry's complete line of Microline instruments are the 38A Test Set (TS 147B/UP) and the AN/UPM-11 Range Calibrator for the accurate testing of X-band radars. These equipments, of rugged design for field usage, can also be employed in laboratory and production testing.

MODEL 38A Test Set (TS 147B/UP)

This portable test set is suitable for measurements on all radar, beacon or missile systems in the 8500-9600 mc. range. It supplies microwave signals of known frequency and power, either continuous wave, frequency modulated or externally modulated. It also measures the power and frequency of external signals in the above frequency range. Model 38A contains a direct reading frequency meter, wattmeter and signal generator which allow the measurement of power and frequency of radar transmitters as well as receiver sensitivity, bandwidth, recovery time and AFC action. Tuning of the frequency meter is accomplished with both a direct and a 5 to 1 reduced drive mechanism for ease of determining narrow pulsed signals as short as 0.2 microseconds.

SPECIFICATIONS:

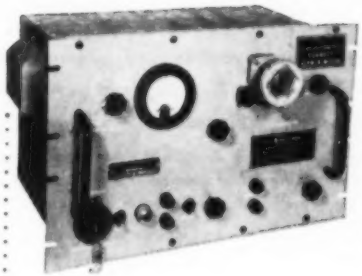
R-F Power Output: Adjustable from −7 to −85 dbm (decibels relative to one milliwatt).

R-F Power Input: From +7 to +30 dbm.

Accuracy: ±1.5db. A calibration chart is supplied.

Frequency Meter Accuracy: ±2.5 mc. absolute at 25°C and 60% RH. Calibration point 9310 ± 1.0 mc.

Our nearest district office will be happy to supply further information on these and other Microline instruments.



MODEL AN/UPM-11 RANGE CALIBRATOR

This instrument is used to test X-band fire-control radars which operate in the 8500-9600 mc. frequency band. It receives microwave signals from a radar and responds with accurately spaced pulses thereby providing a means of calibrating the radar range. It can also be used to boresight the antenna axis of any X-band radar system.

SPECIFICATIONS:

Range Markers: 200 to 50,000 yds. depending on delay line

Accuracy: ± 5 yards

Repeatability of readings (same radar system): ± 1 yard

Tuning: Manual or AFC

* T. M. REG. U. S. PAT. OFF.

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DIVISION OF THE SPERRY CORPORATION

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METAL END FIBRE CANS FOR UNIT PACK AND INTERMEDIATE PACKING . . . For both MILITARY and CIVILIAN USES.

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Fibre container packs are approved and in current use by most of the technical branches of the Government. The uses in civilian applications are becoming more numerous every day.

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Atomic Energy

Colo., or from other Division of Raw Materials' Offices of the Commission.

NUCLEAR POWER STUDY

Five companies, four of which have been participants in previous nuclear-power studies for the past two years, have joined in a new study which has been approved by the Atomic Energy Commission.

The five companies are American Gas & Electric Service Corporation of New York City, Bechtel Corporation of San Francisco, Commonwealth Edison Company of Chicago, Pacific Gas & Electric Company of San Francisco, and Union Electric Company of St. Louis.

The initial objective of the new group is to select a design of a reactor intended primarily for the production of electric power within the near future and to make a preliminary economic appraisal of such a design.

The four utility companies in the group, representing both East and West Coasts and the Middle West, own more than 10,500,000 kilowatts of electric generating capacity with combined annual kilowatt-hour sales exceeding 48.5 billion. The Bechtel Corporation is an engineering and construction company, with headquarters on the West Coast.

All costs of the study will be borne by the companies involved. The contract will run for one year after which a complete report of findings and recommendations will be submitted to the Commission. Title to inventions and discoveries and disposition of reports made in the course of the study will be determined by the Commission under present provisions of the Atomic Energy Act.

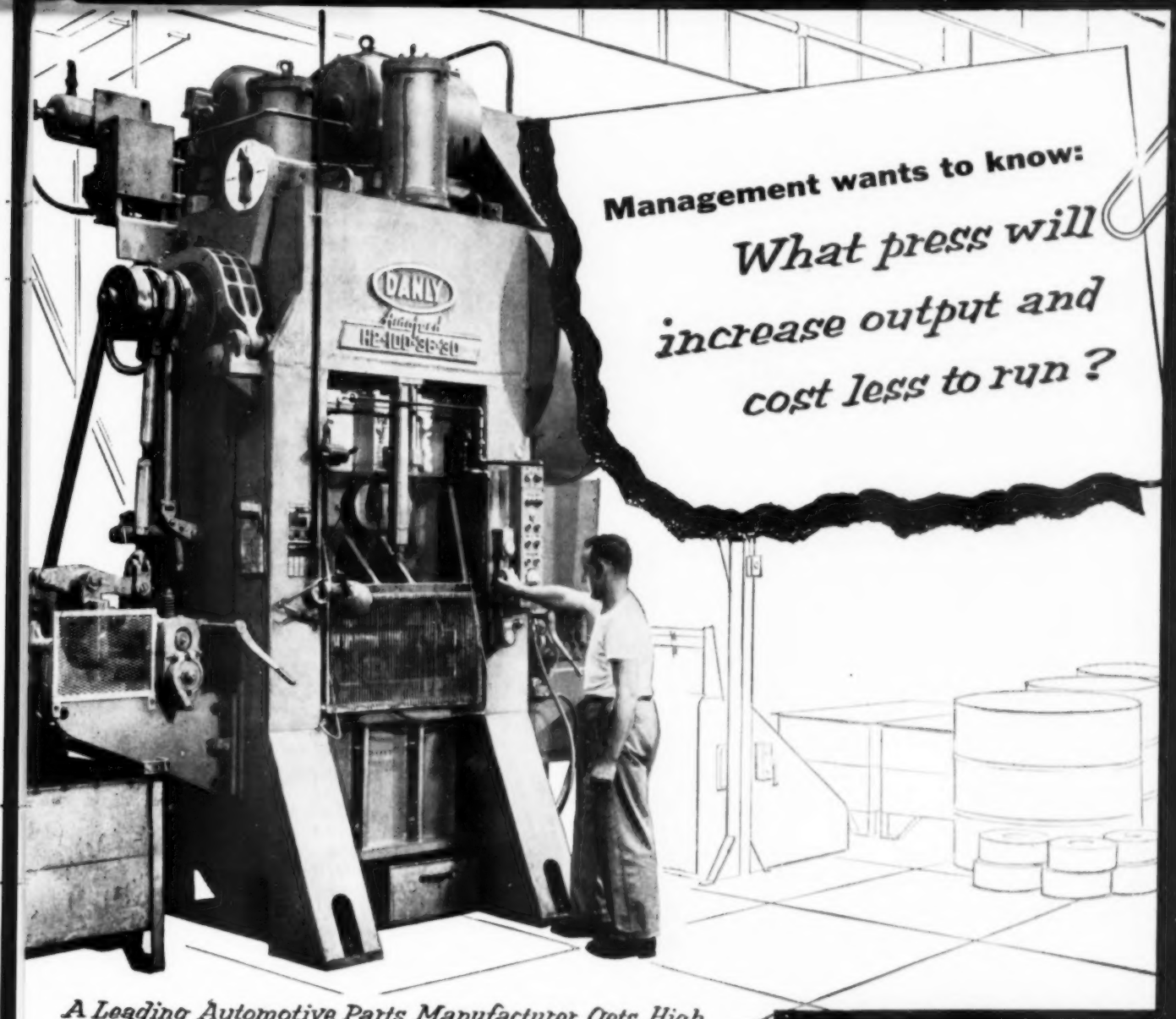
After full investigation, a limited number of personnel in each company will be cleared to investigate pertinent phases of the Commission's nuclear-power program. Access to Commission facilities to an extent commensurate with the scope of the study will be granted.

ATOMIC SHIP PROPULSION

A proposal by the Newport News Shipbuilding and Dry Dock Company of Newport News, Va., for a special study of the application of nuclear power to the propulsion of ships has been approved by the Atomic Energy Commission.

The company developed experience in the nuclear field as a subcontractor on the now-terminated project for an aircraft-carrier reactor. Six of its engineers recently completed studies at the Oak Ridge, Tenn., School of Reactor Technology.

All costs will be borne by the company. The contract will run for one year after which a complete report of findings and



Management wants to know:

What press will increase output and cost less to run?

A Leading Automotive Parts Manufacturer Gets High Operating Efficiency on High Production Jobs with a

DANLY PRESS

Selecting the right press for an intricate die set-up was a difficult problem facing a leading producer of automotive parts. Needed was a *high production* press built for rigidity and precision to extend the life of costly 9-stage progressive dies and improve piece part quality.

What press was specified? A Danly 100-ton Autofeed Press *more than met every requirement* with a remarkably high record of *operating efficiency!* Running full automatic almost continuously through 2 shifts daily, this Danly stamps thermostat valve seats at a rate of 125 strokes per minute.

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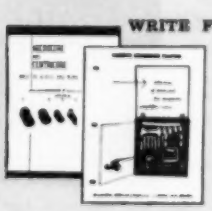

WRITE FOR BULLETIN 53H —"MICROCORES AND CENTRICORES"
BULLETIN 53I—"SELECTION OF MATERIAL FOR MAGNETIC AMPLIFIER CORES"

MAGNETIC METALS COMPANY
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recommendations will be submitted to the Commission. Title to inventions and discoveries and disposition of reports made in the course of the study will be determined by the Atomic Energy Commission after due investigation.

After full investigation a limited additional number of the Newport News personnel will be cleared, if necessary, to investigate pertinent phases of the Commission's nuclear-power program.

At the same time the AEC approved the request of the Foster Wheeler-Pioneer Service power group to add the Diamond Alkali Company of Cleveland, Ohio, as associate in its study of the application of nuclear power.

ATOMIC POWER STUDY

The Atomic Energy Commission has approved an agreement with the Duquesne Light Company of Pittsburgh, Pa., and the Walter Kidde Nuclear Laboratories, Inc., of Garden City, N. Y., governing a nuclear power reactor study.

These two companies make up the sixth team from private industry to engage in power studies under the AEC's Industrial Participation Program. The work will include a survey of the feasibility of design, construction, and operation by private industry of power-producing reactors.

The Duquesne Light Company is a major electric utility serving the Pittsburgh area. Preceding its entry into the study with the Kidde Laboratories, some forty Duquesne engineers attended a special course on atomic energy conducted for the company by Dr. Edward C. Creutz, head of the Department of Physics of the Carnegie Institute of Technology.

Walter Kidde Nuclear Laboratories, Inc., was one of the earlier privately financed atomic laboratories to take an active interest in developing commercial atomic power. In addition to its association with the Duquesne Light Company the organization is currently conducting other studies in this field for the Atomic Energy Commission.

All costs of the study will be borne by the companies involved. The contract will run for one year after which a complete report of findings and recommendations will be submitted to the Commission. Title to inventions and discoveries and disposition of reports made in the course of the study will be determined by the Commission.

Security clearances will be granted to a limited number of personnel in each company so that they may investigate pertinent phases of the Commission's nuclear-power program. Access to the Commission files and facilities to an extent commensurate with the scope of the study will be granted.

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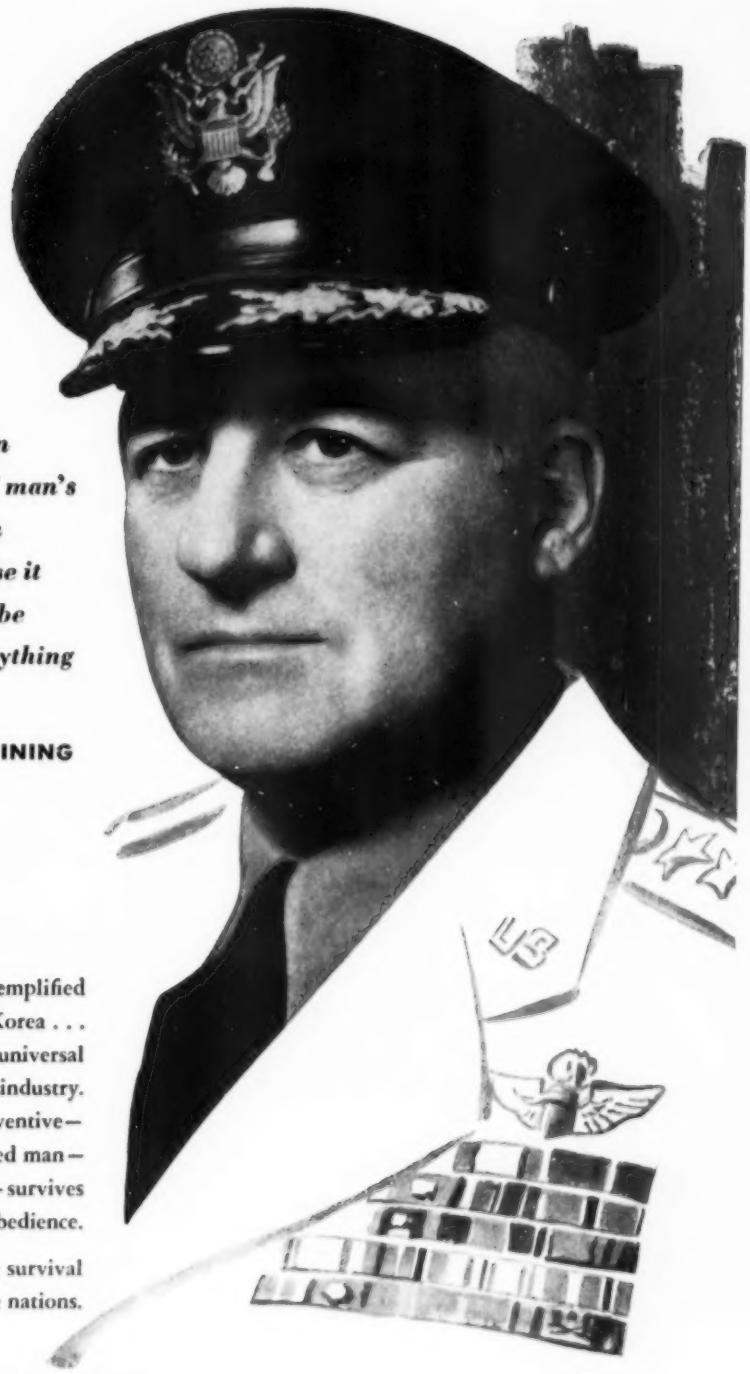
Guide words for today–



"As always, throughout human history, behind every product of man's genius stand the individual men who will either use it or fail to use it successfully . . . The man must be the master of the machine. Everything depends on him."

–GENERAL NATHAN F. TWINING

Mastery of man over machine is exemplified by our overwhelming air victories in Korea . . . and, in another way, by the universal "Suggestion Box" in American industry. Free man – self-reliant, resourceful, inventive– makes the machine his servant. Socialized man– dependent, regimented, enslaved–survives only by mechanical and forced obedience.

This distinction is a key to the survival of free nations.

W. B. Gray

President

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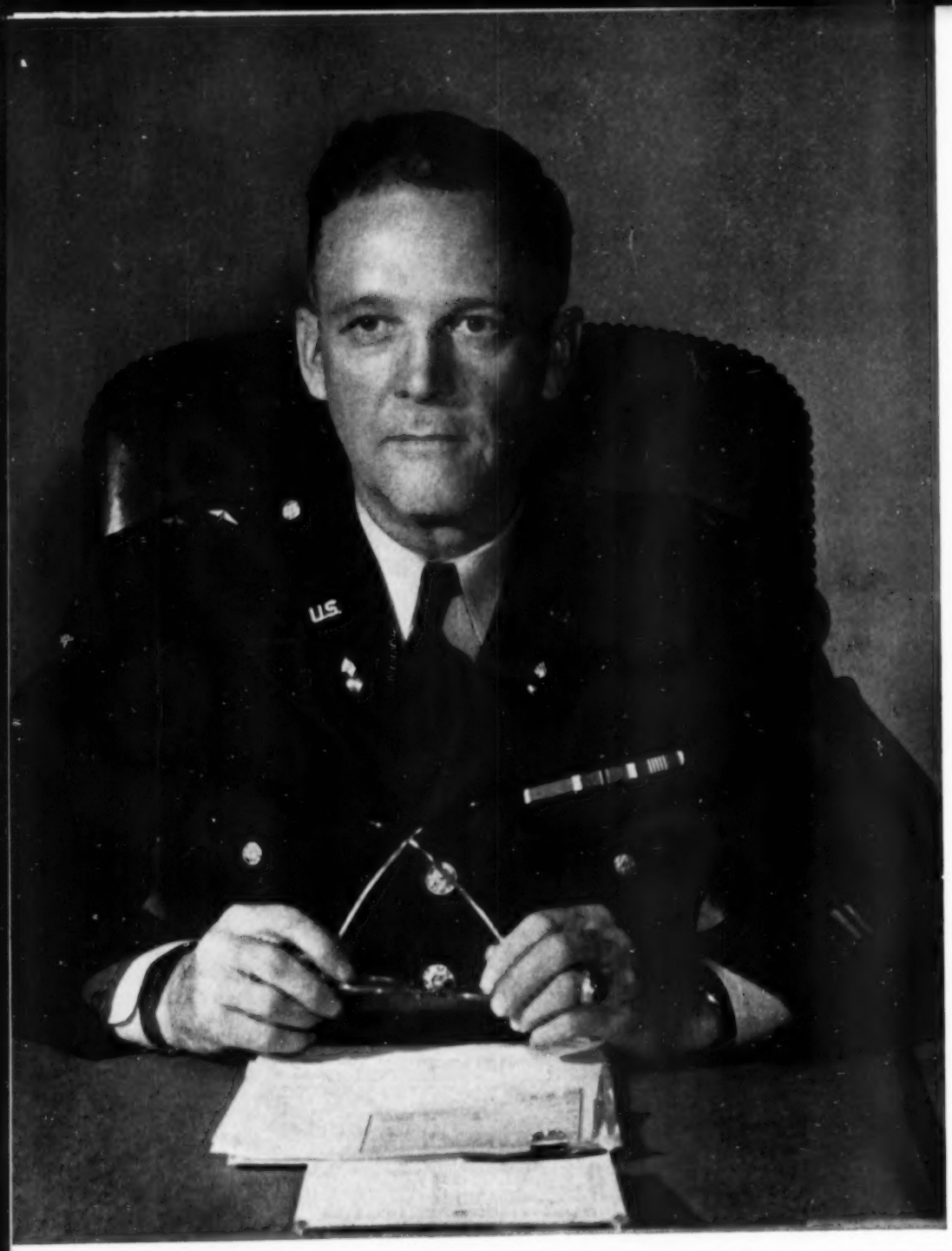


MAJ. GEN. EMERSON L. CUMMINGS

Chief of Ordnance, United States Army

Essence of Security

Superior ordnance is a strong guaranty of freedom and peace

IN one of his celebrated essays, Carlyle asserted that history is the essence of innumerable biographies. Ordnance is an historic organization. It is not a late arrival among the military branches. Our Ordnance history and tradition date back to the War of 1812.

The United States has never been a militaristic nation. We have never believed in a large peacetime standing army. We do not covet the possessions of any other government or people. We regard armed conflict as only the case of last resort for justice and freedom.

This national attitude, while very laudable in some respects, has consistently overlooked the fact that other nations, inspired by different ideologies, have not hesitated, in pursuit of their ambitions, to thrust war upon us and to involve us, against our will, in a fierce struggle for survival.

Under these unrealistic circumstances, titanic effort was required to overcome, in a few desperate months, the ravages of indifference and neglect that had been thoughtlessly inflicted upon our inadequate peacetime military establishment.

IT is to the everlasting credit of Ordnance that, despite all obstacles and handicaps, highly professional and patriotic leaders kept alive and nurtured ordnance technology so that, in a war emergency, this priceless knowledge and hard-won experience could be made available to civilian industry.

The history of Ordnance was written, down the tumultuous years, by great men, by farsighted and dedicated men, by men of steadfast courage and faith in America.

Out of the gallant Army Ordnance host that contributed so much to the Nation's welfare and safety during the past 142 years, we would like to single out for special commendation and commemoration the giant men who met the wartime challenges of their day with matchless wisdom and resolution—Bomford and Talcott in the Mexican War, Ripley and Ramsay in the Civil War, Flagler in the Spanish-American War, Crozier and Williams in World War I, Wesson and Campbell in World War II, and Ford in the Korean War.

Maj. Gen. Emerson L. Cummings, twentieth Chief of Ordnance in the 142-year history of the Corps, has had thirty years of military service.

Born in New Boston, Mich., in 1902, he was graduated from West Point in 1924 and commissioned a second lieutenant in the Corps of Engineers.

He received degrees from Cornell and Massachusetts Institute of Technology and is a graduate of the Ordnance School, the Command and General Staff School, and the National War College.

In 1936 General Cummings was transferred to the Ordnance Department and assigned to the Office of the Chief of Ordnance, Automotive Section.

Other peacetime assignments of General Cummings included instructing at the Ordnance School, Aberdeen Proving Ground; automotive, artillery, and engineering specialization in the Office of the Chief of Ordnance; and chief of industrial operations in the Tank and Automotive Center, Detroit.

In Europe from 1945 to 1947, General Cummings was chief of the Industrial Division, European Theater, in Paris and Frankfort, and was appointed Deputy Chief of Ordnance in that theater. Returning to this country he was assigned to the Office of the Deputy Chief of Staff for Logistics at Army Headquarters, Washington, D. C.

From 1950 to 1953 he served as Chief of the Industrial Division, Office of the Chief of Ordnance, and assumed his new duties as Chief of Ordnance on November 2, 1953.

MODERN Army Ordnance superiority in matériel and personnel began under General Crozier in 1901. Not only was the Sandy Hook Proving Ground a preëminent pioneer establishment in testing, but in all other respects Ordnance, under General Crozier, was made ready for the new era of technology and mechanized warfare.

Maj. Gen. C. C. Williams (1918-1930) directed the Ordnance Department after World War I so effectively that it was able to assume the tremendous burdens of World War II.

Maj. Gen. Charles M. Wesson (1938-1942) was responsible for the swift and efficient transition of Ordnance from a peacetime to a wartime basis.

Realizing that World War II would be a production war, Lieut. Gen. L. H. Campbell, Jr., (1942-1946) sought the advice, assistance, and coöperation of American industry, thereby creating the most powerful and successful Industry-Ordnance Team in history.

Maj. Gen. E. L. Ford (1949-1953) directed deliveries of new ordnance matériel for the Korean War that climbed from almost negligible quantities to approximately eight billion dollars' worth annually.

It is now our happy privilege to greet Maj. Gen. Emerson L. Cummings, the twentieth Chief of Ordnance of the Army, and to pledge him utmost support and coöperation. We are certain that he will add luster and distinction to the magnificent tradition which his distinguished predecessors have confidently bequeathed to him and that he will carry that tradition to new heights in the atomic age.

Key to Preparedness

National policy determines our military planning: it stems from the President and the National Security Council under the advisement of the Joint Chiefs of Staff who recommend military strategy

Adm. Arthur W. Radford
Chairman of the Joint Chiefs of Staff

WHEN the new team of Joint Chiefs of Staff took office on August 15, 1953, we found ourselves confronted with a budget cycle that was already under way. Planning for fiscal year 1955 could not wait for us to complete all the studies we wanted to make.

Congress convenes next month. The President must deliver a coördinated executive budget request in its opening days. Working back from having in hand a coördinated executive budget, you can see right away that it is necessary for Mr. Wilson's Department of Defense budget to be completed some weeks in advance of that.

If you work back still further from the single coördinated defense budget, back to where the services must have certain information upon which to compute price tags, you will see then that the new Joint Chiefs of Staff had a very short time, indeed, in which to solve their immediate problems.

In other words, there had to be an Interim Look, one tied to the budget-planning cycle for fiscal year 1955. It was a matter of high priority. Consequently, the Joint Chiefs of Staff had to meet frequently and to stay in session for hours at a time in order to arrive at some of the basic conclusions so essential to our defense programming.

The key to our military planning is found in our national policy. National policy stems from the President and his National Security Council. It is the function of the Joint Chiefs of Staff to advise the President, the National Security Council, and the Secretary of Defense.

This address was delivered by Admiral Radford at the Thirty-fifth Annual Industrial Preparedness Dinner Meeting of the American Ordnance Association at the Waldorf-Astoria Hotel, New York City, on December 2, 1953. It was one of the first major public statements made by Admiral Radford since assuming the chairmanship of the Joint Chiefs of Staff.

Because of the importance and timeliness of Admiral Radford's remarks, they were preprinted and mailed to all the members of the American Ordnance Association with the December issue of THE COMMON DEFENSE, *the monthly Washington newsletter of the A.O.A.*—THE EDITORS.

Accordingly, the Joint Chiefs of Staff recommend the military strategy necessary to carry out national policy. We develop and recommend those plans that have the broadest conception of over-all national interest rather than the particular desires of any one segment.

IMPORTANT qualifications for such military planning effort are that it be timely; that it be based upon the best obtainable intelligence; that its strategic concept be designed to deter or to win a war; and that its logistic support be in balance with strategy and be reasonably within the realm of attainability.

IF these conditions are met in the course of concurrent strategic and logistic planning, the result will be a group of joint military plans which will: (a) chart our capabilities to fight an immediate war, (b) establish the military and industrial-mobilization goals necessary for a war for which there may be time for partial advance mobilization, and (c) take a long look into the future in order to project long-range military strategy and objectives and provide guidance for technological advancement.

Sometimes, despite the best planning efforts, plans have to be changed. Circumstances change. Occasionally, plans need rapid readjustments to meet an unforeseen situation. In other words, plans need to be continually reviewed and coördinated if they are to be effective and kept up to date.

For example, a few years ago this Nation faced what we now recognize as a period of imposed reckless military economy and cutbacks preceding the Korean war. That was 1949. The Nation seemed almost oblivious to danger with a defense budget of only $13 billion and with less than 1.5 million men under arms.

This was followed by a hasty build-up because of the outright Red aggression. That was in June 1950. As you businessmen will recall only too well, the United States was literally galva-

nized into action and leaped to a strength of 3.5 million men and women in our armed forces.

We certainly had our ups and downs —our peaks and valleys. As a result, those fluctuating pressures—the closing and opening of our preparedness throttles—have in themselves generated many of the pressing problems with which we are confronted today.

No one could foresee in 1950, with any degree of certainty, whether the war in Korea would be confined to Korea or would lead to a global war. Korea was just one small part of the greater Communist aggression that was bleeding our freedoms. It cost us large sums of money, much of our resources, and, gravest of all, far too many of our sons.

Fortunately, by 1950 our economic-mobilization planning already had been given a broader base. The industrial-mobilization planning of the National Security Resources Board and of the Munitions Board recognized continuing international tension and the "cold war."

It gave particular priority to measures of economic readiness such as the stockpiling of scarce raw materials, the establishment of plant and equipment reserves, and the conservation of such critical resources as power, steel, and manpower.

HOWEVER, both the military and industrial-mobilization planning of this period were aimed primarily at possible all-out war and not at what happened in Korea in June of 1950.

Later, the Korean conflict necessitated a retailoring of our military planning to meet isolated outbreaks short of total war and brought about a marked change in the pattern of all our planning. The sudden realization of national peril created an overwhelming requirement for war production which, if uncontrolled, could have led to serious economic dislocation.

We needed sufficient weapons to give us military superiority in Korea and to supply the armed forces during the early period of possible global war, but not the all-out massive production we would have needed if all-out war had materialized.

Such a rapid build-up, when time was being telescoped, was bound to result in crash planning and programming. No one could be certain of the aggressor's intentions.

Now, with hindsight, perhaps you and I could envisage how some matters might have been handled differently. Instead of looking back over our shoulder, however, let us look to a more constructive evaluation of where we stand today.

Let us look at the world situation as it would affect a current review. Briefly speaking, and with considerable oversimplification, there has been no reduction in the truly vast militant force with which the Soviet Union continues to threaten the free world. The Soviet Union has enormous natural resources and a rapidly growing industry. It has a numerical superiority in land armies. It has powerful air forces. It has naval forces second only to the United States.

It has buffer states with which to conduct limited wars. It controls its peoples with an iron hand, and its foreign policies are in no way guided by the same moral restraints that guide our policies. In addition, it has been concluded that the Soviets have the capability of an atomic attack upon us.

TO obtain their objectives, the Soviets excel at a 3-pronged system of operations: politico-economic, military, and psychological-propaganda prongs. Since militant Communism is a triple threat to the free world, it must be countered in all three areas. If any one prong receives a setback, the Soviets then push hard along the other two.

Because of this, there are a number of sensitive hot spots around the world. It is characteristic of Soviet strategy to create situations which pose to us courses of action, all of which are unpleasant or which have definite disadvantages for us.

These sensitive spots continue to be troublesome and continue to have a bearing upon whether or not we shall have peace. Such areas as Korea, Indo-China, Iran, and Berlin are but a few examples.

To establish conditions under which peace can best be sustained and at the same time provide deterrents against aggression, we must continue to support the United Nations, the world instrument charged with these responsibilities. To achieve these ends requires calm, deliberate reflection.

But, peace depends mostly upon a small group of men in the Kremlin. This is one of the hard facts of international existence which we must accept. It is within the power of this small Soviet group to decide upon a shooting war, to make such a decision

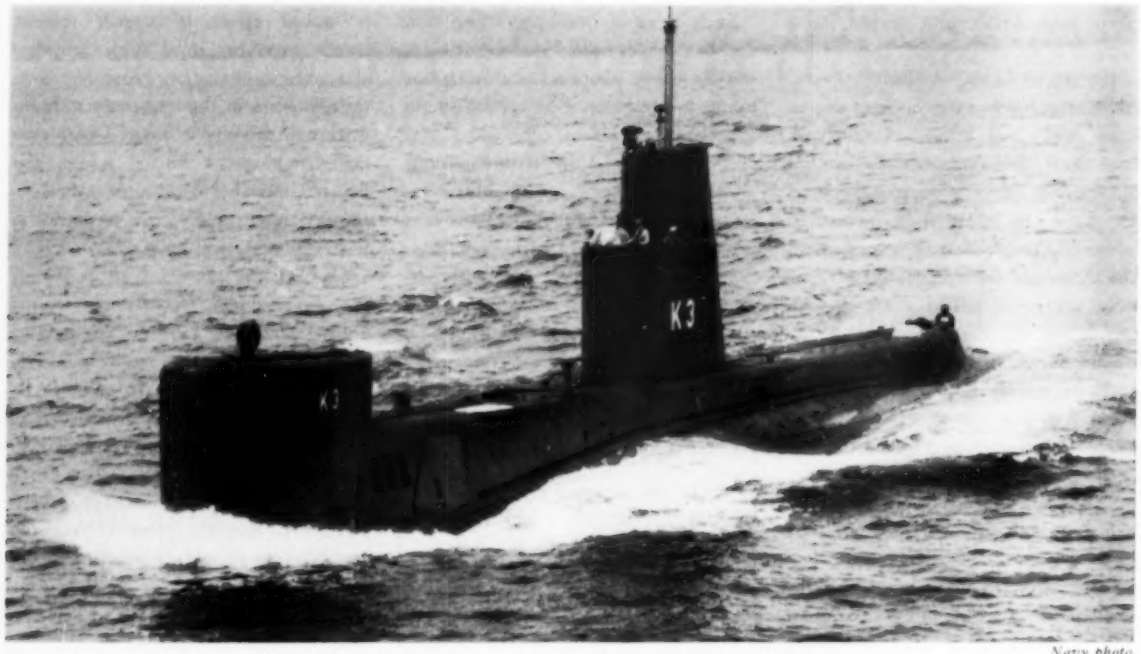
On the occasion of its Thirty-fifth Annual Industrial Preparedness Dinner Meeting, the American Ordnance Association presented to Admiral Radford its Blandy Gold Medal in recognition of his distinguished service to the national defense with the following citation:

"The American Ordnance Association salutes Adm. Arthur W. Radford, Chairman, Joint Chiefs of Staff of the United States, for his leadership in directing the armed strength of our Nation in peace and in war.

"A champion of balanced forces, Admiral Radford participated in campaigns in the Pacific during the Second World War wherein the coördination of our ground, sea, and air forces was tested to its maximum effect and reflected upon him great credit in the conduct of modern tactics embracing sea and air operations.

"As Commander in Chief, Pacific, his support of Korean operations with the joint forces under his command, including the full strength of the Pacific Fleet, was accomplished with masterful singleness of purpose and skilled integration of our fighting forces.

"In recognition of his outstanding contribution to our national defense the American Ordnance Association confers upon Admiral Radford its Blandy Gold Medal with expressions of admiration for his leadership and of coöperation in his present weighty responsibilities."



Navy photo

Men and matériel are the major factors in preparing for national defense.

secretly, and to make the initial attack with little or no warning. We cannot close our eyes to this fact.

Actually we are faced, even now, with *their* idea of war. The fact that it does not involve the massed onslaught of military forces does not detract from the fact: This is war today. Wars can be, and are, fought in other ways as well.

In view of these, and other planning factors, the new Joint Chiefs of Staff considered it absolutely mandatory that we not make any recommendations for radical changes—especially not on any overnight basis. In discussing this with Secretary Wilson, we agreed that the best defense plans and programs will come about through evolution, if we plan deliberately and with wisdom.

WE further agreed that, even though our military plans are based primarily on military factors, we must also take into account a wider range of policy and economic factors as well as the latest technological developments.

Therefore, in accordance with our established national policies and commitments, in October the Joint Chiefs of Staff submitted their recommendations for combat forces for fiscal year 1955. The forces recommended do not represent any material change from those developed in previously approved plans, except, of course, for certain increases we recommended for continental defense.

NEITHER do these forces represent a decision to carry on just as before, merely for the sake of resistance to change. They represent interim levels, pending the formulation and completion of a longer-term program which continues under study. They represent a step in what I call our planning for the long-term pull, in lieu of a particular year of crisis.

The Joint Chiefs of Staff propose to meet their force requirements, including the recommended increases in air forces and in continental defense, within the predicted manpower availabilities. It is also our objective to realize certain economies in manpower, money, and material when feasible.

In this day and age, the military must be realistically concerned about keeping our national economy solvent as an indispensable bulwark of the free world. It is a most important facet of our national security problem.

In making our recommendation, the Joint Chiefs of Staff have maintained that changes in the armed forces are coming in the light of both the changes in the world situation and the changes in our weapons and doctrine. New weapons lead, of course, to new techniques of warfare.

Today there is no argument among military planners as to the importance of air forces. Offensively, defensively, and in support of other forces, they are a primary requirement. There is no question but that the United States will maintain national air power that is superior to that of any other nation.

YET now, and for an indeterminate period in the future, air forces must be complemented with other forces. Land forces, amphibious forces, antisubmarine warfare forces, and other well-rounded forces are going to be necessary in either a small war or a large war.

Our security, and that of the free world, cannot at this time be entrusted to an unbalanced—a unilateral or a bilateral—concept of forces. This is true in Western Europe, Korea, and Indo-China today. It would be true in any other active theater of operations. It is equally true, however, that the balance in one situation may not be the proper balance in another.

As for continental defense, we want

to see its programming proceed on an orderly, nonhysterical basis, with phased increases in forces and facilities to meet any and all threats. We want to see approved programs consummated at high priority.

At the same time we want to guard against a tendency to overcommit resources to purely defensive measures which would detract from other essential security programs.

Most military leaders over the past half century have been convinced that the safest and surest defenses begin where the enemy begins his attack, and not at his destination. Undeniably, one of the most effective means of defense is the deterrent effect of a strong offensive capability.

No one has yet offered argument or proof that this principle is not just as sound today as it has proved to be in the past. Certainly it is more applicable today to air warfare than it ever was to land or sea warfare.

At the same time we must keep up our guard against the attack that may strike our homeland. Therefore we should proceed with a realistic continental defense program—a stepped-up program—to build an effective defense system consistent with the most realistic strategic concepts for national security.

Accordingly, much is being done to improve the United States defense against atomic attack, to give us better eyes to detect incoming aircraft, and to give our defenses—our interceptors, antiaircraft, and civilian defense—time to react.

We are building a system that will have the means of early warning, well-coördinated communications, and efficient control of fighter-interceptor aircraft and antiaircraft weapons. It requires the closest coördination, not only among the services but also with our Canadian friends to the north.

WITH regard to Europe, the European Defense Community concept—the political-economic-military union of Europe's resources—offers to Western Europe a prospect of security and prosperity never before achieved. As long as the present general world situation continues, and as long as there exists firmness on the part of these European nations to fight for themselves, we must help them preserve their freedoms.

Our rôle is that of a partner in collective security. The United States is a full-fledged member of NATO. That organization is rather unique in that a group of nations has joined in a common military organization before, rather than after, a general war has broken out.

We have pledged our support to the collective defense of the NATO community. We are proud of the commitments we have made—commitments which are unprecedented in history. We have lived up to our commitments in the past, and we will continue to do so in the future.

Here, too, the maintenance of sound economies for the long pull ahead is of major importance. It would be fruitless to erect defenses if, at the same time, we ruined either the economy of the United States or the economies of our allies. . .

As for Korea, today we have a truce. It is not a peace. Korea should be considered in its proper perspective as but one part of the greater campaign against freedom. No one should regard the armistice in Korea as portending any abandonment of the fundamental aims of Kremlin Communism any more than abandonment of the guerrilla warfare in Greece, or of the Berlin blockade, carried any such portent.

As in those instances, stopping aggression in Korea simply means that one tentacle of Soviet Communism has been denied the prize for which it was reaching.

But there are other tentacles, and there are other prizes that sooner or later these tentacles may stretch out to seize. What might be feared is that a truce in Korea may tend to bring about a letdown in the vigilance and energy of our efforts, just as has happened many times before. This must not be allowed to happen.

Remember that the Soviet Union has no time limit for the accomplishment of its objectives. Their goals are so long range in concept that they can be achieved at any time it is expedient.

It is the job of the military to look soberly at the Communist threat. We know what the capabilities are. We know their weaknesses and their strengths. We do not know their intentions.

Nothing would please me more than to be able to plan for peace and to cut back on the size of our combat forces. We must, however, be ready for an emergency. It is only by having a force in being, ready to meet imminent danger, that we can insure security.

As successful industrialists and businessmen I know that you will agree that throughout all national planning and operating there has to be constant effort on the part of both civilian and military agencies to keep requirements and capabilities in balance.

Our planning generates the military requirements upon which are based the type and extent of the mobilization effort of the Nation. In fact, all industrial-mobilization planning is based on military planning and planning for essential civilian requirements. If one is good, the other can be good.

The credit for the good and for the bad should be shared alike. Industry and the military must work closely, and in mutual confidence, if a sound industrial-mobilization base is to result.

IT is difficult to predict what our armed forces will be like a decade or so from now. There is no set blueprint. We live in what can truly be termed an era of change. All about us significant transitions are taking place—political and international transitions, fabulous scientific developments for good and for destruction. The armed forces will go through a process of evolution as a result of their own imaginative and creative efforts; and counter-evolutions will undoubtedly be imposed on us by the inventiveness of others.

The Department of Defense is aware of its responsibilities on the civilian-military team in planning for industrial mobilization and is striving earnestly to do its part. I believe you know your part, too. If war should be forced upon us, I am confident that, with your help, the Nation's military and industrial might will be mobilized speedily and effectively.

Man—the Ultimate Weapon

The soldier is the absolute weapon upon which our national defense rests, and his equipment, his training, and his morale are still the vital factors in balancing our security equation

Gen. Matthew B. Ridgway
Chief of Staff, United States Army

THE purpose of an army—its task, its goal, its reason for being—is victory in war.

Throughout human history to date, there have been wars. During our own national existence the United States has found itself at war no less than eight times—once every twenty-two years. Today, the threat of war, which might materialize unannounced and with devastating effect, is ever present.

There was a time when the end of hostilities brought political negotiations, the imposition of reparations, the cession of territory. But for the government and for most of the people of the defeated nation, life went on much as it had before. Defeat for us today, or in the future, would be catastrophic.

The day when wars had limited effects is past. The physical and economic ruin sustained by defeated nations, the loss of life, the deterioration of their moral standards, are facts which recent history shows are indisputable. War, if it comes again, will be total in character. It will affect the whole social, economic, and political fabric of the nations involved.

THIS has been brought about by the vast strides in technology which have occurred in the past century and a half; by the enormous increase in international economic interdependence which technological progress has developed. Today, war would not be waged solely between military forces, but between entire societies.

Moreover, the history of the past eight years, when the people of nation after nation lost their cherished freedoms, when subversion and the *coup d'etat* became the normal tools of unscrupulous and power-mad men, makes it clear beyond doubt that there exists a sinister threat to world peace.

It may well be that the time will come again when we in America will have to fight to preserve the values we cherish. If we must fight, we must win. There can be no other goal. There must be no other outcome.

Against this background, and from my sincere and heartfelt convictions, I am going to discuss your Army and its rôle in national defense—a subject which can be approached from many directions but which I shall treat from the viewpoint of men, matériel, and morale.

MAN is the dominant factor in war. We Americans view with distress the loss of life and the utter devastation which are the hallmarks of twentieth-century conflicts. Our basic values—our fundamental beliefs—all stem essentially from respect for the individual.

This respect has many facets—the safeguarding of individual rights, the regard for human dignity, the respect for human decency, the conservation of human life. War sharply restricts our individual freedoms.

No one could be more anxious than I to reduce both the manpower requirements of the Army and its casualties in combat. At the same time, I have a responsibility to my civilian superiors in the Department of the Army and the Department of Defense, to the President of the United States, and through these officials to the American people. That responsibility stems from what I said earlier—that if our Nation is forced into war, it must win.

And I say to you now that notwithstanding new weapons with immensely increased destructive power, notwithstanding the developments in transpor-

This article is based on an address given by General Ridgway at a recent meeting of the Cleveland Post, American Ordnance Association. At that time the Post awarded General Ridgway the Crowell Gold Medal with the following citation:

"The Cleveland Post, American Ordnance Association, salutes Gen. Matthew B. Ridgway, Chief of Staff, United States Army, whom they have unanimously chosen as the recipient of the Brig. Gen. Benedict Crowell Gold Medal for 1953.

"The members of the Post and their fellow citizens throughout the land are deeply grateful to General Ridgway for his preëminent service for our national defense as exemplified by his outstanding record in war and in peace, at home and abroad.

"The Crowell Medal symbolizes not only their admiration but their gratitude and their hope that in his present important assignment as Chief of Staff of the United States Army the same high success will crown his efforts."

tation which have brought all points on the earth's surface within a few hours of each other, the ultimate determinant of military victory still is the trained fighting man with his feet on the ground.

It is true that man fights in three elements—in the air, on and under the sea, and on land. But man remains a land creature. The day of space ships and of interplanetary bases still lies ahead.

THE length of time during which this land creature can operate in the other two elements is steadily increasing. Yet it continues to be limited by the fuel, the ammunition, and the food which ships and aircraft can carry, and by the rate of consumption of these supplies.

Airplanes still must land. Ships must still make port. The bases from which they operate are still vulnerable to attack, and if destroyed or captured or even badly damaged, the fighting elements which they support can no longer operate effectively.

But even if such destruction or capture were accomplished there would still be no prospect that this alone would bring conclusive military victory. There would still be fighting armies to defeat.

The ultimate stake in wars is the control of bits of this earth's surface and of the people who inhabit them. It may be that at some distant date this control can be exercised by a threat from sea or sky alone. Yet it would be a dangerous, perhaps even a fatal fallacy to conclude that this date has now arrived.

Deep-rooted in man is love of the land of his birth. This is as true in the lands of tyrants as elsewhere. In fact, history has shown it to be one of the strongest supports of tyrants who in their aggressive designs invoke its influence to divert attention from their tyrannies.

If Communist-controlled regimes unleash war against us or our allies, we shall find this true. We shall be compelled, in order to attain victory, to break that control—and we shall not break it by threats alone.

England did not bow in 1940 to the threat of punishing blows from the air. Germany did not surrender in World War II, though her flag no longer flew at sea and her armies and peoples took the heaviest punishment of aërial bombardment ever known. Japan did not capitulate until her naval and air forces were destroyed, her armies decimated and isolated, her home islands wide open to the invasion of enemy armies which she no longer had hope of defeating.

We learn lessons from these historical facts. They prove what all of military history to date has proved, and with ever-increasing clarity in modern times, that there is no magic in the successful conduct of campaigns—that sound planning and timely preparation of properly balanced military strength offer the only way by which we may expect successfully to defend ourselves.

Weapons incalculably more powerful than those of the past are now available, and their power goes on increasing. Yet they, and the services which use them—and these now include all our armed services—have but one unchanging purpose—to deter aggression, if possible, and in the event we are attacked to loosen the enemy's control over his means of waging war and so bring him to his knees.

In the pursuit of this objective, the rôle of armies remains unchanged.

The problem of evaluating the effects of new weapons and new techniques is exceedingly difficult of solution. It is under continuing and intensive study. The Army will not neglect the potentialities of either the weapons we now have or of those soon to come. We shall not fail to combine the new with the old; to adopt the new, when tests validate this course; nor to discard the old for like reasons.

In doing this our Nation may, at some future date, substantially alter the ratios of land, sea, and air strength in our present military establishment. But no evidence yet adduced today would validate such a course. Perhaps it never will.

New weapons, history shows, have a way of canceling out. The advantage to the offense of one new weapon today is soon neutralized by the development of a corresponding one for defense. The domination of the battlefield by one nation, with new weapons and weapon techniques, is sooner or later counterbalanced by those of a potential enemy.

Neither of the great power groups in the world can expect to maintain indefinitely both a dominant offensive capability and an assured defense.

Yet there is still one absolute weapon—the employment of which dominates every consideration of national security—the only weapon capable of operating with complete effectiveness—of dominating every inch of terrain where human beings live and fight and of doing it under all conditions of light and darkness, heat and cold, desert and forest, mountain and plain. That weapon is man himself.

The striking technological advances of the past 150 years, while they have profoundly enlarged the scope and scale of warfare, have in no way diminished the importance of the human being in battle. Rather they have increased his importance and while subjecting him to greater hazards have placed greater demands upon him.

EACH of the changes in technical capabilities has brought changes in tactics. Each has required changes in organization. None has resulted in reduced over-all military manpower requirements. All have made increasing demands for skills and leadership.

One of the most significant tactical developments has been the consistently greater dispersion of troops on the battlefield and with it a steady decentralization of the responsibility for tactical decisions.

The eighteenth-century sergeant's duties in combat revolved chiefly around the requirement to maintain alignment in his platoon, to see that men from the rear rank stepped forward to fill the gaps when men in the front rank fell. He would be utterly lost if forced to fill the boots of the modern infantry noncommissioned officer.

In the Army today there are thirty-

two distinct career fields. Each of these is a major specialty in its own right. To cite a single example of the standard required, a soldier of average or above-average intelligence should complete no less than 128 weeks—2¼ years—of training before he is properly trained to perform the duties of an infantry squad leader—before he should be entrusted with the lives of others in battle. For a platoon sergeant the necessary training time is greater, and for higher ranks, greater still.

Naturally, this is due in part to the increased complexity of weapons. But it is at least equally due to the increased degree to which tactical decisions must be made and effective leadership exercised in even the smallest combat units.

THUS, the soldier's capabilities have increased through the increased capabilities of his weapons, but the demands made upon his skill, his intelligence, and his character have likewise increased. These demands reach their peak in battle under conditions of maximum danger, fatigue, and confusion.

Recently, I returned from a trip to the Far East and Alaska. In the course of my inspection I saw the men in Korea alert to check and counter the possible resumption of Communist aggression. I saw the men who are keeping vigil in the North, standing faithful guard against possible attack which could come unannounced. In Greenland, in Panama, and along the Rhine, other American soldiers are ready for whatever emergency may arise.

These men are performing a vital service—just as vital to us here as to others who love freedom overseas. It is their readiness, their presence in critical areas, which constitutes today another of the great deterrents to war.

It is their presence which makes Soviet-led Communist aggression against friendly countries of Western Europe and of the Far East more improbable of success and therefore less likely of occurrence.

It is their presence on the far sides of the oceans which surround us which heartens free men and women and strengthens the cause of freedom everywhere. Any premature withdrawal, any ill-advised weakening of their position, can be a grievous blow to freedom.

I have been speaking to you of men, the basic element of armies. I do not underestimate the vital importance of weapons and machines. No army in the world has benefited more by the technical improvements in weapons than our own. Always anxious to gain maximum return from every ounce of human effort, every risk of human life, the United States Army developed its basic military doctrine around the concept of firepower—for firepower and the ability to maneuver it rapidly are foundation stones of our military doctrine.

This concept has been derived from the lessons of American history. At Bunker Hill it was the intense and accurate volume of individually aimed rifle fire which wrought havoc in the ranks of the British troops, armed with muskets and bayonets, firing by volley on command.

At Buena Vista it was the rapid and destructive fire of American artillery, gallantly served by a handful of cannoneers, which shattered Santa Anna's charging troops.

The trademark of the American soldier of World War I and World War II was the weight and accuracy of his fire.

In Korea, once again, was demonstrated the value of the close industrial support of our military forces. It was the massed firepower of the American soldier which balanced the weight of massed manpower of the enemy's callous "human-sea" tactics. Thanks to the industrial productivity of the American people and to the strength of the American economy, our combat units today are the hardest hitting, man for man, of any army in the world.

We have recently given our Army atomic weapons. We shall add others as time goes on. The increase in firepower will be tremendous. The effect on tactics evolutionary.

It is not possible to assess with any degree of accuracy the saving in life which has been made possible in battle by America's industrial productivity. However, some idea of the scale of industry's support can be gleaned from statistics on the production accomplishments of World War II. Between July 1940 and November 1943 alone, munitions output increased almost fifteenfold.

By August 1945, the total value of the munitions which had been produced since July 1940 exceeded $183 billion.

These impressive totals were achieved in spite of the shortages of manpower inevitably accompanying mobilization, in spite of the shortages of vital raw materials caused by enemy seizure of important strategic areas and enemy submarine interference with sea transportation.

I know that American industry, if called upon to do so, will match and surpass its magnificent achievement of World War II and of the past three years. Reliance on that great capability is one of the most important factors in the Army's ability to fulfill its function successfully. It is another of the major safeguards of peace.

Thus far, I have spoken of men and matériel.

I now want to discuss morale—the third, and in many ways the decisive element in the military trinity.

NO matter how well armed, no matter how well trained, without that vital element of morale—without the will to win, the will to close with an enemy and destroy him—no army will win in war.

There is a maxim attributed to Napoleon that the moral is to the physical as three to one. This is a truth to which every experienced combat soldier wholeheartedly subscribes, only he would, I think, greatly increase the ratio.

Inspired by the will to win, the determination to prevail whatever the odds, men will in the future as they have in the past accomplish prodigies of valor. Our history is filled with examples.

I want to remind you of a few exploits of American troops which should be known to all our people. At

Bastogne during the Battle of the Bulge, outnumbered, surrounded, and cut off for eight days from any contact with supporting ground forces, our valiant troops under courageous leaders withstood onslaught after onslaught by numerically overwhelming and heavily mechanized enemy forces.

It is no detraction from this epic achievement to point out that, in essence, those gallant men of the United States Army were merely repeating an heroic pattern. Let me cite a local example from the War of 1812, less well known than it deserves to be—the defense of Fort Stephenson on the banks of the Sandusky River where the town of Fremont stands today.

The fort was no more than a log stockade with rudely built blockhouses. The garrison numbered hardly 160 men commanded by Maj. George Croghan. The assaulting force comprised 400 British regulars, including artillery, and some 2,000 Indians led by Tecumseh.

Although the attackers completely surrounded the fort, although a horrible death at the hands of the Indians seemed the certain consequence of resistance, the Americans met the enemy's demand for surrender with steadfast refusal.

THROUGHOUT the night and most of the following day British cannon bombarded the little American garrison. Late in the afternoon, the British commander launched an assault by which he expected to take the fort by storm. The attackers were met by a hail of deadly fire. After repeated assaults the enemy was driven off, abandoning not only the attack but the entire campaign.

Through its gallant stand the garrison of Fort Stephenson not only saved itself from destruction but so discouraged the British that other offensive operations against more important American posts in the Northwest were discontinued.

Bastogne and Fort Stephenson are in the tradition of many of your Army's battles—New Orleans, Fort Sumter, Battan and Corregidor, and Chip Yong-Ni in Korea, to name only a few of the better known.

"No matter how well armed, no matter how well trained, without that vital element of morale—without the will to win, the will to close with an enemy and destroy him—no army will win in war.

"There is a maxim attributed to Napoleon that the moral is to the physical as three to one. This is a truth to which every experienced combat soldier whole-heartedly subscribes. . . .

"Inspired by the will to win, the determination to prevail whatever the odds, men will in the future as they have in the past accomplish prodigies of valor."

Not all of these battles were crowned with tactical success, but all were minor epics in the great current of American military history, and they all revealed what can be accomplished by men who fight with faith in God and in their ideals. They all show, as do innumerable examples, the ultimately decisive effect of the ultimately decisive factor —indomitable individual spirit, or morale.

Morale is not achieved by order. It is not something that comes from without. It germinates in the human heart; it feeds on the human spirit; it draws sustenance from kith and kin; it is intangible—a spiritual strength that enables men to endure sacrifices up to death for the things they hold dear.

It springs from a clear realization of what is most precious in life—what is worth fighting for, what is worth more than life.

It comes from a faith in the ideals and spiritual values which have made our Nation great and which have sustained us in every crisis. It is a faith which imbues men with a sense of privilege, not of enforced obligation, when they are called upon to serve the Nation and the cause of freedom.

It inspires men to come to their great tasks as did the fathers of our country, who in the hour of decision pledged to the cause of liberty their lives, their fortunes, and their sacred honor.

It imbues men with the spirit of those millions of gallant men and equally gallant women who, in all the wars our Nation has been obliged to fight, saw the shape of things as they were and stood up to them in defense of their faith.

This is the spirit which makes sacrifice acceptable and hardships endurable; which overcomes doubt and the misgivings of timid hearts. This is the spirit which brings victory. It is the spirit which acknowledges no obstacles. It is American leadership at its finest, and the record of response to that leadership is among the proudest of America's annals.

The United States Army, representing and serving the people of the Nation which created it, derives its strength and its spirit from that people of which it is an integral part.

All earthly things are relative. All material things pass and are replaced. But spiritual values remain—constant, imperishable.

As long as free men are endowed with an inextinguishable faith in God and an unquenchable love of freedom under God; as long as they harbor a burning determination to preserve their heritage of freedom—then no weapons, however new and destructive, however awesome their potentialities may appear to be, can ever conquer them.

These are the elements—men, matériel, and morale—which combine to make an effective Army. We can afford no other kind. The world is in an era of profound change. Whether this is to evolve in peace or to erupt again in war is beyond our power alone to control.

Because of this, war can come. If it should, then the final issue will hang again on the outcome of the struggle between armed men locked in land battles.

YOU may rely on your Army. With its sister services it stands guard today in the far-flung outposts of the free world, ready and resolved to play its full part in building collective security for freedom, in heartening our allies, who are in greater danger, in preserving the peace, and in winning in war, if war should be unleashed against us.

Fission or Fusion?

The tremendous possibilities of atomic power indicate that United States military and industrial technology must explore the field of thermonuclear research to the fullest

Mark S. Watson

WHEN the first atomic bomb burst over Hiroshima, heralding the end of the Pacific phase of World War II, a great many people thought happily that it also heralded the end of war itself. It was reasoned—or hoped, anyway—that an explosive more than a thousand times as powerful as anything in previous history must surely demonstrate the futility of resistance and hence the futility of any aggressive war in which retaliation could be so destructive.

The hopes did not last long. True, the Bikini tests in 1947 were offered in proof of that optimistic notion—observers from all nations, including Russia, were invited, partly on the theory that Bikini's evidence would convince them of the folly of a new style of war.

But the only visible effect on the Russians was to stimulate their nuclear research in quest of something better, and to this, most fortunately, the Western observers' response was quite similar, so that when 1952 rolled around several startling phenomena were visible:

RUSSIA quite clearly had developed a fission bomb of her own, and America just as clearly had not only developed much more powerful and also more compact fission bombs, plus an artillery shell with such a war head, but had exploded at the Eniwetok proving ground a "thermonuclear device" (in the meticulous language of the scientists) which assured the practicality of a new bomb of the *fusion* type. And the new type, in its turn, is one thousand times more powerful than the bomb that destroyed Hiroshima.

Mr. Watson is a well-known military analyst and holder of the 1945 Pulitzer Prize for international correspondence. He is the author of several books including, "The War Department, Chief of Staff." At present, he is a member of the staff of the Baltimore Sun.

That is where we are today, with one important addition: We have every reason to think that Russia is close behind us with a thermonuclear knowledge, if not technology, that is likely to catch up with ours very soon.

In consequence we again hear expression of the same hope we heard enunciated in 1945—that the mere existence of such weapons must convince all nations that there is no profit in war, even for the victor, and hence there must and will be agreement to have no war.

This is not merely pious hope. Up to a point it is solid reasoning, for what rational statesman can believe that even a prospective victor will be content if, while the war lasts, the weaker foe still is able to launch a last-gasp counter-assault with bombs that have an explosive power comparable to *thirty million tons* of TNT?

Hopeful or reasonable, the idea must be examined in the light of our post-Bikini experience. If experience be a guide, one may predict that while actual *employment* of such a missile in a new war may be an act of madness, there nevertheless will be *preparation* of such missiles as a purely defensive step—for unmistakable employment if an enemy uses them against us.

Threat of overwhelming reprisal remains the surest preventive of enemy aggression, and when one talks today of "overwhelming reprisal," he is all but naming the H-bomb.

We—and Russia as well in all probability—have the scientific knowledge of how to convert the "thermonuclear device" into the true H-bomb; we have the technical skills and resources to achieve the feat; and we would be reckless if we doubted Russia's ability to follow.

TO think that in this situation we will ignore these facts and leave the H-bomb undeveloped is as rational as it would have been for our ancestors to have gone on using the bow and arrow after gunpowder became available.

Prohibition of nuclear weapons through a reliable international agreement may come about in our lifetimes. It should, and so should nonaggression agreements generally. But the moral issue, and the rational issue as well, will be found in the aggressive decision to start the war, not in the choice of weapons.

The first reform must be that of the statesmen. And while the statesmen are preparing the reform, the Defense Department is wisely engaged in its

own preparation, with no idea of opposing the reform but rather with a frank hope that its preparations will hasten the reform by making its necessity more apparent to reasoning men of all nations.

Recent developments have been staggering, not only in the actual achievement of what once was only probability but also in the transformation of possibilities into new probabilities—and in the visualization of still newer possibilities.

THESE half-incredulous looks into an expanding future, opened by the new research into what atomic-fusion (symbolized by the H-bomb) can bring to pass, tend to lessen our sensitiveness to the great progress in atomic-fission (symbolized by the A-bomb) which is at hand, or at least in the nearest bush. We would do well to examine, as far as permitted by present excessively cautious "security" restrictions (of which, more a little later), some current examples:

1. There has been a great deal of conjecture about the application of fission principles to our weapons. When the new 280-mm. gun was announced to have atomic capabilities, it was apparent that earlier ideas about the need for a very bulky bomb case (by reason of the supposed "critical mass" plus the bulky controls once of necessity built about it) had been markedly revised.

The whole projectile obviously now could fit within a gun barrel of 11-inch diameter; hence the bomb now could be transported by planes much smaller than a B-29 (as quite generally inferred long ago), and other forms could constitute the war head of a moderate-sized torpedo, depth bomb, or guided missile.

This reality has long been manifest to ordnance experts examining the announced Army, Navy, and Air Force projects. It now is manifest to the public, and speculation on a very wide variety of new-weapon potentialities (and realities) is as free as air and considerably more solid.

2. Apart from weapons, development of controlled fission for propulsion is far advanced. The launching of the experimental submarine NAUTILUS is scheduled for the current month (January 1954) and its friendly rival, U.S.S. SEA WOLF, seeking fission-propulsion by a second power-extraction method, will follow in time.

The Navy's bold pioneering in this field, like its historic pioneering in high-pressure turbines, electric drive, and other enterprises quickly adopted for merchantmen once their practicality was proved, has lately brought the anticipated result: Newport News Shipbuilding has announced its own interest in applied research and development looking toward employment of atomic fission for propulsion of large surface vessels.

The fact that the Air Force has called off an initial adventure in seeking atomic means of airplane-propulsion indicates only that the inevitable result of that particular research would have been a poor airplane. The next Air Force project may afford better promise, and, if not, still another project must be initiated.

3. Promise of early development of a stationary power plant likewise became firm in October. Such a plan is to be set up with the dual purpose of producing fission material and power. It is high time, too, for British technology is developing one such plant today and is embarking on a second plant. Sweden is following suit.

An atomic cloud surges skyward during recent Nevada tests (Marine Corps photo).

It must be remembered that Britain has a special spur which we lack—British coal and oil are extremely expensive so that there the costliness of fission power is not as large a consideration as in this land of relatively cheap fuel.

Indeed there is substantial reason for believing that, efficiency and economy alike considered, Britain actually may be able to produce its power from the atom more cheaply than from coal. There is a respectable forecast that within five years a very considerable amount of Britain's power will come from that source.

Something else must be remembered. If Britain is impelled to that practice, how about Russia? And if industrial use of the atom is pushed to development, with private capital providing hitherto untapped resources of scientific spirit, skills, and technological facilities, there will undoubtedly be a fresh spurring of interest in further weapons possibilities.

POLITICAL, economic, and military reasons alike warn us, then, that the United States must very quickly get away from the excessively cautious views of "secrecy" which thus far have discouraged American public knowledge of facts and theories which are wide open to foreign technologists. For in this country public knowledge is almost an essential preliminary to public pressure upon the Government, and public pressure is a lively stimulant to governmental action.

Fortunately, President Eisenhower himself stepped out last October with a partial indication of new problems being raised by nuclear developments, and we can expect a good deal of official pressure now to get Congress to revise radically the Atomic Energy Act.

Devised when we thought we had a monopoly on nuclear thinking, the act set up "secrecy" regulations which to-

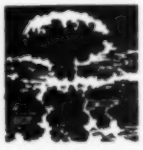
day hamper our own progress. Certainly they do not hamper Russia's, and certainly, even here, they do not bar conjectures which go far beyond the cautious expressions to which the Atomic Energy Commission and the Defense Department are restricted. Some of the statements, partly conjectural, widely offered in recent months are these:

1. That atomic fusion (as distinguished from fission) is not, as once thought, "impractical" and "hopelessly expensive." Many scientists a decade ago believed it just as practical as the fission process, but were outvoted. As a result, fusion research was halted, and our wartime energy went into fission research, which in fact produced the A-bomb.

THE bomb was followed by revolutionary progress in nuclear fission for nonbomb purposes through controls which permit, instead, power production for propulsion or industry. Had we, in 1942, gone instead into fusion research we might be a lot further ahead today.

2. The last Eniwetok experiment with the "thermonuclear device" established its practicality beyond doubt and produced an explosion which renders obsolete a great many widely held present notions about protective shelters.

3. The 1952 explosion appears also, thanks to later appraisals, to have demolished the "expensiveness" theory. Indeed, it now seems clear that the fusion bomb, as measured by relative damage, is much cheaper than the most efficient fission bomb. And there is warrant for believing that its cheapness will be found to be more than relative.



4. Early doubts of practicality were based on assumptions that the H-bomb is operative only through the prior creation of stupendous heat, itself attainable only through an A-bomb explosion; hence it was reasoned that the "triggering" with the A-bomb simply added that cost to the other cost.

Here we get into the officially "secret" area, but there have been published conjectures either (a) that the necessary preliminary heat is somewhat less than once was theorized, or (b) that it can be produced in a less expensive manner.

There is in any case a bold conjecture that the end product can be attained without any such staggering capital outlay as we have put out in our pioneering and that a much smaller and poorer nation, granted our knowledge and technical skills, can make its own independent capture of fusion energy.

5. The familiar term "H-bomb" is being discouraged as inaccurate. That is, we at last can say publicly what nuclear scientists have been saying for years—that if atomic fission can be achieved with uranium, or atomic fusion with hydrogen, they can be achieved with other elements as well.

It was quickly demonstrated that other heavy atoms can be readily fissured, and now it is as well recognized that various elements at the lighter end of the atomic scale can be fused by thermonuclear action.

Theoretically, at least, this applies not only to the deuterium and triterium variants of hydrogen, but to its neighbors up the scale, such as lithium. These light elements are plentiful in earth's economy—another factor in the relative cheapness and availability of fusion-bomb energy.

To repeat, it is nothing short of reckless to work on the assumption that horror alone over the possible use of a thermonuclear bomb with all its awful powers of destruction will prevent the making of such a bomb by nations which already are fully committed to both the making and the employment of the fission bomb—a fairly horrible thing itself by normal calculation.

For, as just noted, the lighter elements are universally available and cheap in readily separable compounds, wherein there is a clear advantage over the heavy elements from which we produce the fission bomb. And the thermonuclear bomb's output of explosive energy, as remarked, is vastly greater than the fission bomb's, which provides a further advantage.

To repeat again, development of controlled power cannot be fully separated from research into explosive possibilities from the same source. Each enterprise is likely to help the other achieve a common goal.

The difficulties of controlling fusion energy for industrial purposes are admittedly much greater than difficulties in controlling fission energy (by reason of the stupendous heat engendered, with which no presently employed metal or plastic can cope), but few scientists are so timid as to term them unconquerable.

We must look forward to industrial use of fusion energy on an immense scale and in the not-very-distant future, and we must prepare to exploit the lead which America now enjoys, not to surrender it.

And that supports the belief that we cannot afford to block American study of atomic fusion as a producer of weapons for war as well as of industrial energy for peace.

There has been an unfortunate tendency to rely too much on the so-called "poison-gas parallel"—that is, on the fact that in World War II nobody dared use his own poison gas in battle lest the enemy counter with it. (Even so, our troops were trained in gas-resistance techniques and in gas-projection techniques also, just in case). That was, indeed, part of the reasoning for the nonemployment of gas.

ANOTHER part was that new weapons and techniques were figured as being more efficient than gas anyway. The "parallel" thus becomes a poor one, for no country has yet turned up with anything more efficient in destruction than the fusion bomb.

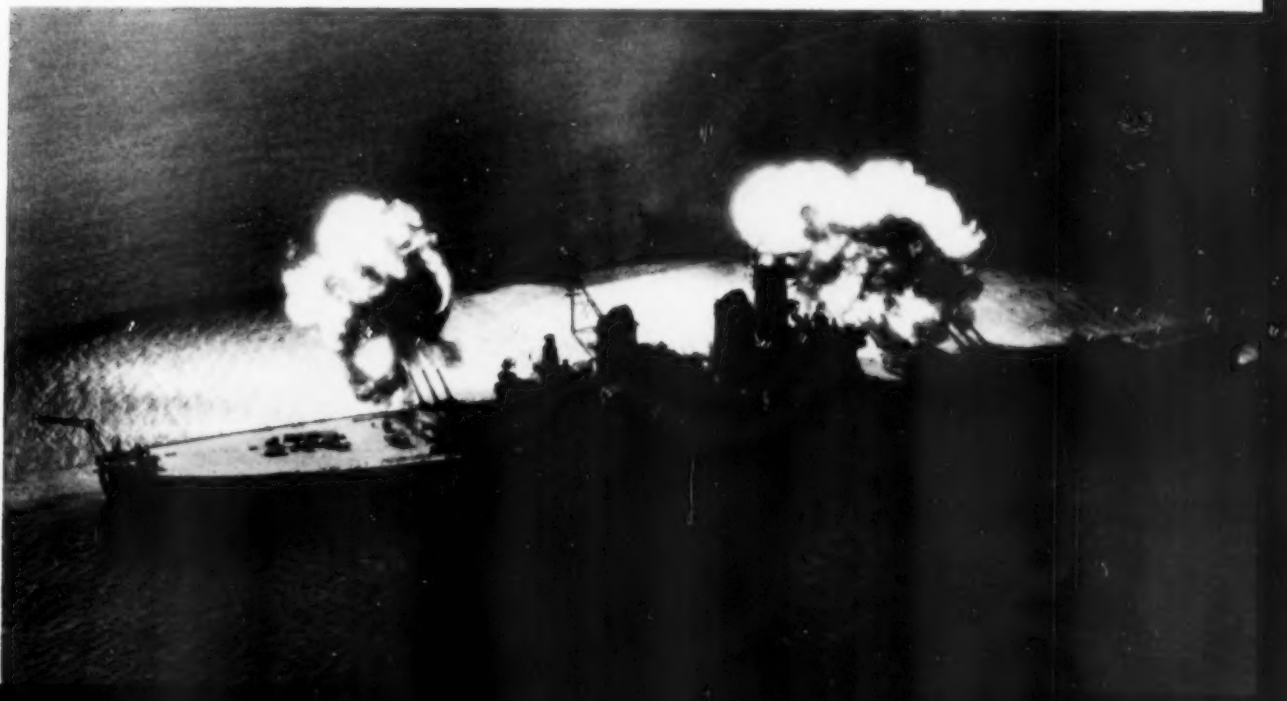
We are, in brief, forced to proceed with fusion-bomb development as a counter to the enemy's inevitable strides in that direction and with nuclear-power development as well, for the same reason.

To do so quickly and effectively, Congressional action must break some of the overcautious "secrecy" fetters which still bind America (and not the enemy), and thus encourage far wider knowledge of the good and bad possibilities with which an informed public must concern itself if our Government is to have the intelligent support which a firm policy requires.

Firepower Afloat

The Korean War underlined again the ability of the United States Navy to bring superior firepower to bear, quickly and effectively, on any target along the sea frontiers of an enemy. Armed with the most modern ordnance equipment, Navy ships and aircraft are ready at all times to defend American freedom in all parts of the world. The aircraft carrier and the jet airplane have extended the striking range of today's Navy so that it is still "Our first line of defense" as the accompanying Navy photos on these pages indicate.

Above, gunnery practice aboard the aircraft carrier U.S.S. TARAWA during recent maneuvers in the Mediterranean. Below, the battleship U.S.S. NEW JERSEY fires nine 16-inch guns in one salvo during bombardment mission in Korean waters.

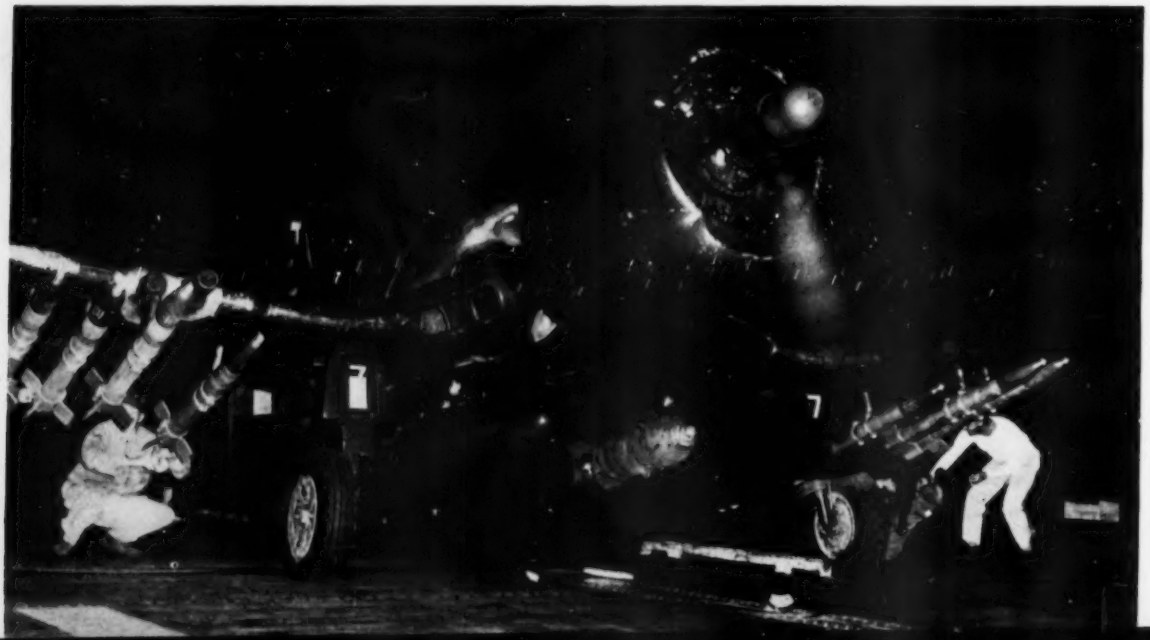


Above, ordnance personnel load Marine F4U fighter bombers with rockets and napalm aboard the U.S.S. BADOENG STRAIT off Korea. Right, the battleship MISSOURI fires its secondary batteries during recent practice maneuvers. Below, crewmen aboard the U.S.S. WISCONSIN man their battle stations in Far Eastern waters off Japan.

The U.S.S. MANCHESTER, above, fires a 6-inch broadside salvo into Communist installations at Wonsan, Korea, during a naval bombardment by Task Force 77.

Unblurred by the blast, a smoke ring rises from the secondary batteries, right, aboard the U.S.S. LOS ANGELES during a recent firing mission in Wonsan harbor.

Above, crewman checks fuze on 2,000-pound bomb mounted on Navy "Skyraider" aboard U.S.S. PRINCETON. Antitank rockets are attached to wing. Below, ordnancemen make final check on F4U-4 prior to take-off from U.S.S. SICILY.



Air Defense, U. S. A.

The problem of providing both offensive and defensive air power in maximum amount to discourage aggression, protect the Nation, and remain within a reasonable economic framework

Gen. B. W. Chidlaw

IN discussing the air defense of our country I would like to present certain ideas held by those of us who must live closely with the awesome responsibilities of our Nation's air-defense problem; ideas which ultimately may help to develop a broad national philosophy toward the problems of air defense—a national philosophy which must be known and understood and shared by every citizen.

First, let us look at the problem. Is there a threat to our country? Yes, there *is* a threat!

The Soviet Union created an atomic explosion in September 1949, and their stockpile of atomic weapons most certainly has been growing the past four years. We *know* that the Soviet Union has copied and improved upon our 4-engine bomber, the B-29, and has built over a thousand of those improved planes.

We *know* that this airplane—stripped of all except the necessary navigation and bombing equipment—has the range to reach and attack the principal target areas of our country, and we *know* they have still better and faster planes under development and test.

We *know* that several months past the Soviet Union exploded a thermonuclear device, the forerunner of a development which can lead to the H-bomb.

Whether the Soviet development of the latter weapon proceeds at such a rapid pace as to impose a threat tomorrow, next week, or next year would seem to me a somewhat academic question since the threat of the older atomic weapon—the A-bomb—certainly cannot be disregarded.

General Chidlaw is commanding general of the United States Air Defense Command, Colorado Springs, Colo. This article is based upon a recent address by General Chidlaw before the Cincinnati Post of the American Ordnance Association at which time he was presented with the Post's Charles L. Harrison Medal for Distinguished Ordnance Service.

Yes, the threat *is* here—now!

Communist doctrine, for over a hundred years, has presented an unaltered intention to achieve world domination. The history of the Soviet Union since the fall of the Russian monarchy furnishes unimpeachable evidence of its determination to reach that goal.

Today, among the free nations, the United States is the only one with the power, the necessary resources, and a full determination to take the lead in establishing a barrier between Communism and its objectives.

TODAY the Soviet Union has the capability to attack us through the air with weapons which, if delivered without interference, could, in a single series of coördinated blows, destroy our industry, immobilize our military forces, and emasculate our will to resist.

Conceding that this great threat exists, it behooves us to provide the "interference," since it could be national suicide *not* to prepare to defend ourselves, in growing measure, against such a growing threat.

Since those scientists and military experts closest to our air-defense problem will agree that such a thing as a one hundred per cent perfect defense is neither technically nor economically feasible at this time for a country as large as the United States, two questions are immediately apparent:

(1) How much air defense *can* we afford? and (2) How much air defense can we *not* afford to be without?

I am frank to admit that I do not know the answer to the first question.

I ADMIT with equal frankness that I *do* know—generally—the answers to the second, for the answers to that question are found in the principles which govern the establishment of an air-defense system. These principles generate certain requirements, and failure to meet any *one* of these requirements seriously reduces the effectiveness of any system we might devise.

What are these principles? They are fairly easy to state—but more difficult to accomplish! Basically, there are only about four.

The first principle—not necessarily in order of importance—is that the system must provide sufficient warning and protection for our offensive striking forces to insure that the initial enemy attack or series of attacks will not reduce to an ineffective level our capability to deliver counterblows—to strike back harder and with greater force.

It is a dead certainty that *no* defense system, no matter what degree of effectiveness we ultimately attain, can—alone—bring victory. Consequently it is vital that we be in a position to take immediate action—not only to reduce the enemy's attack capability at its source but to proceed methodically and quickly to destroy his war-making capability.

THE military force most capable of launching an immediate retaliatory counterattack against *all* critical target areas of a potential enemy is our Strategic Air Command. A defense system which fails to provide the warning time and the air protection necessary to preserve that offensive capability is not fulfilling its mission.

The second principle is that the air-defense system must provide sufficient protection for the Nation's economy—its industries—to assure sustained support for military and industrial warfare.

As industrial leaders familiar—through constant contact—with our mobilization matériel requirements you are aware, I am sure, of the rapid development and ever-changing nature of today's weapons of war. Because of this rapid and progressive development, the obsolescence rate of weapons is comparatively rapid.

It is thus impractical and beyond good, hard common sense to attempt to create—other than in the atomic stockpile—huge reserves of today's weapons much beyond that "mobilization reserve" necessary to permit our essential war industry to swing into high gear for the military program. A careful balance is mandatory.

Protection of our essential defense industry to insure *tomorrow's weapons* is equally mandatory—protection to the maximum level we can achieve within the defense system in being.

The third principle is that the defense system must provide sufficient protection for the people of this Nation to assure their physical and psychological ability to operate our military and industrial machine. In my book this is perhaps the most important principle.

IT would be of little purpose for us to protect our military forces and our industrial war potential if we, while so protecting, accepted such destruction of our population—permitted such blood loss—that the people of the country were unable or unwilling to fight back.

Should fear or panic ever destroy the *will* of our people to fight, regardless of our military posture or industrial potential we could eventually lose to the enemy by default.

And, fourthly, the defense system as finally determined must be established within the economic capability of this Nation to build, maintain, and *sustain* a combined offensive-defensive "survival force."

This last principle is perhaps the most difficult of all to assess fully.

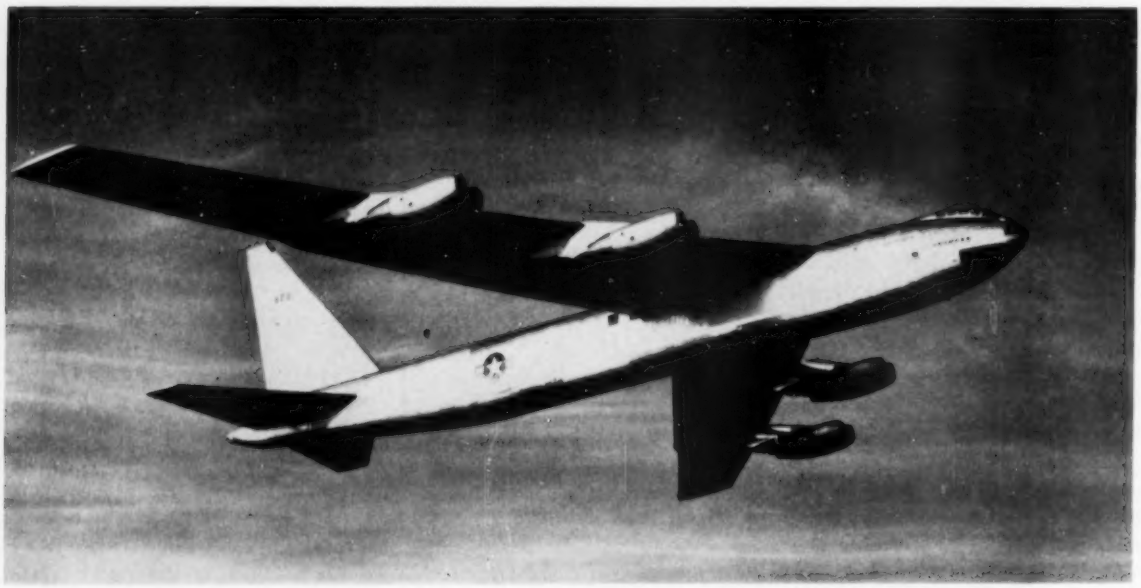
There would, it seems to me, be little purpose in building a purely "defensive" system so elaborate that the cost would bankrupt the country—leaving little of value to defend—or leaving this Nation without an adequate offensive force in being to carry the war to the enemy.

Measured against the terms—the magnitude—of the problem, it is well within the realm of possibility to design unwittingly, at the expense of the offensive effort, such a purely "defensive" system.

To see that this is so, consider for a moment what we must defend against—the speeds and altitude capabilities of the modern bomber, the accurate navigation and bombing devices which are characteristic of modern air weapons.

Consider the almost unlimited avenues of approach available for selection by the enemy.

Remember that the time—and place—of an attack will be dictated by the attacker—not by us.



The 8-jet Boeing YB-52 "Stratofortress," latest and largest of United States bombers (Air Force photo).

Think of the size of the area (over three million square miles) and the number of critical targets (hundreds upon hundreds) that must be defended.

To meet this threat requires a system that will provide adequate warning—a detection capability extending far enough outward from the targets to allow time for interception and air battle by our fighter planes. We must have the maximum "early warning" attainable in order to bring our military defense system to its fullest effectiveness and to alert our civil-defense system to the fast-approaching danger.

Our air-defense system requires high-performance interceptors capable of making interception in darkness or any kind of weather.

It requires antiaircraft guns and ground-to-air guided missiles for close-in protection of specific targets.

It requires one of the most complex communications systems ever devised by man.

It requires real estate—often very valuable real estate—on which to locate the fighter squadrons, the radar bases, the antiaircraft guns, and the guided missiles.

Above all it requires highly skilled people—thousands upon thousands working round the clock—to operate the complex equipment and still more people, less highly trained perhaps, to provide the essential support for the air and ground combat crews.

It can readily be seen that almost any amount of money could be spent. To determine the *maximum* amount that could be spent on an air defense system is relatively easy—ceiling unlimited! But that isn't the answer we are looking for.

The determination of the *minimum* level of air defense required to carry out the principles I have outlined is the real answer we are after. It requires intensive and continuous study at the highest levels, and I assure you that such determination of air defense requirements *is* receiving constant attention—*is* under constant study—by our top civilian and military leaders, by the National Security Council, by the Joint Chiefs of Staff, by our intelligence and internal-security agencies, by the Office of Defense Mobilization, and by the Federal Civil Defense Administration.

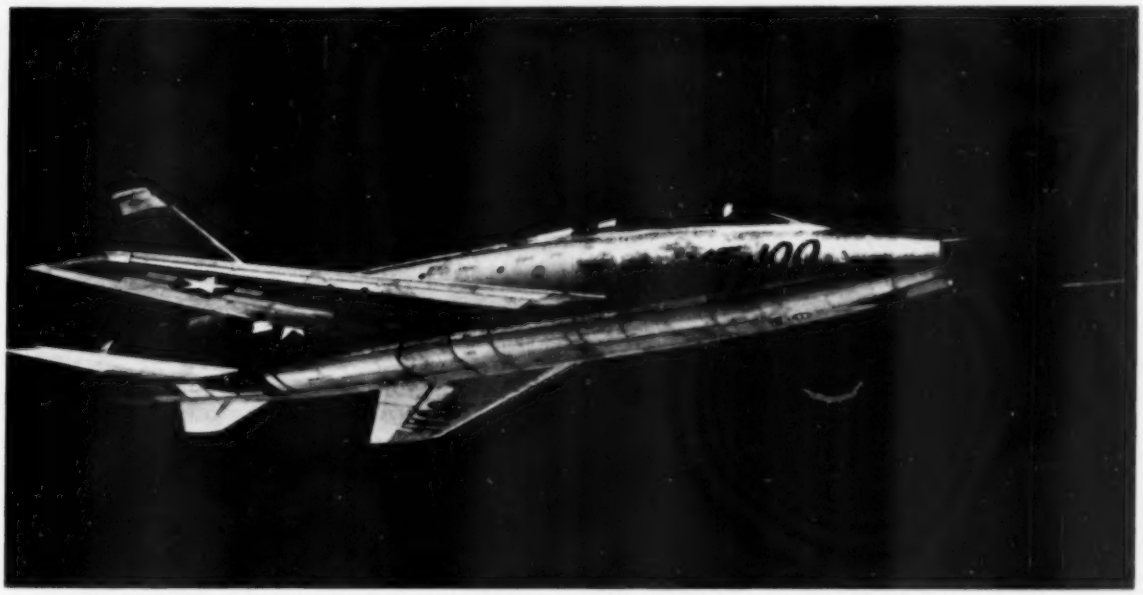
IN the final analysis, these same leaders are responsive to the highest authority in the land—the people.

The recommendations of our civilian and military agencies regarding the scope of our national air-defense effort can only be put into effect if we have the full support of the people. To have that support, we must have a complete awareness—a complete understanding—by the general public of the peril confronting us.

Since, in this atomic age, our only real security lies in *preventing* war, the man in the street must realize that if we are to avoid the horrors of a war fought with weapons of mass destruction this Nation *must* attain and maintain a military posture of both offensive and defensive potential which will deter our enemies from ever launching the initial atomic strike against us.

The maintenance of such military posture is expensive, will continue so, and will entail sacrifices by our people over a period of time, the length of which no one today is competent to foretell.

However, I feel that the danger with which we are faced today is so grave that every organization and every group in the country must add to its already established objectives the objective of establishing an understanding of the Nation's military problem in the mind of every individual American, but establishing this awareness in such a fashion that he can face up to the problem—not in fear or in panic—but calmly and objectively, with full determination to help in its solution.



The F-100 "Super Sabre," first operational jet fighter to exceed the speed of sound in level flight (Air Force photo).

Dynamic Defense

An industry-ordnance team in being, constantly prepared to swing into maximum production with a minimum of notice, is our best insurance for national security today

Hon. John Slezak

AS you all know, several months ago I took on a new job as Assistant Secretary of the Army for Matériel. In this capacity I am responsible for the procurement of matériel, construction, transportation, and other material needs of our Army, and it is in this capacity that I recognize and appreciate the tremendous importance of the American Ordnance Association to our national defense.

Since its inception thirty-four years ago, the A.O.A. has been one of the strongest factors in keeping America strong.

"Peace through strength" is a motto I have heard again and again at our meetings. As a matter of fact, during the dark days of the early 'thirties when appropriations for Ordnance were around $12 million a year as compared with over $20 billion for the year 1942, your Association was about the only voice in the wilderness that tried to keep alive the interest of our Nation in the preservation of whatever know-how of ordnance manufacture we had retained.

WHAT all of this meant when 1941 arrived can never be properly evaluated. Names such as Campbell, Walsh, Codd, and many others will never be forgotten in the history of American Ordnance.

The work of your Technical Committees alone would have justified the existence of the A.O.A. However, important and valuable as the work of the Technical Committees may be, it is only a part of the huge contributions you are making to our national-defense structure.

Your "Reserve Ordnance Production Capacity" report is making a tremendous impact on Department of Defense thinking, and you no doubt recognize many of your recommendations in some of our policies as they are issued from time to time. Our production capacity stand-by policy is a good example.

As you no doubt remember, with the end of hostilities in 1945 we not only wrecked our Army but also our industrial potential to recreate it in a reasonable time. The production lines were broken up and scattered. Tools were separated from their machines, and the machines themselves ended up in dozens of different places all over the country.

Industry bought the best machines, and dealers wisely picked up much of what was left. With the exception of some single-purpose equipment, the Government was left, by and large, with the dregs and the scraps.

Mr. Slezak is Assistant Secretary of the Army, Department of Defense, Washington, D. C. At a recent meeting of the Chicago Post of the American Ordnance Association, Mr. Slezak was awarded the Association's Campbell Gold Medal. This article is based upon the address he delivered at that time.

Very little or no effort was made to keep production lines and their tools intact. Again and again tools and dies from various ammunition-component lines were thrown loosely into crates and shipped to a depot with no indication of the plant or the machine or the product concerned.

THANKS to better guidance and understanding, we are not making those mistakes again. Our stand-by capacity policy can essentially be divided into three categories. In the first category belong the cases in which entire factories for the production of some complicated long-lead-time items are held intact for production readiness.

A good example of this group will be the tank plant in Cleveland when it closes down. The entire plant will be left intact with machines in place—everything ready to run. Of course this is not as ideal a situation as having a plant in operation, but it is the next best thing.

One of the big advantages of this arrangement is the fact that plant and management are tied together. The executives of Cadillac know they will be expected to operate this line in another emergency, and they are keeping up the buildings and machinery now. They can plan on their wartime job and take it into consideration in their day-to-day management decisions.

This continuous association of management with a plant and product should save many dollars and many lives in a future war.

Sometimes we find that the entire

plant cannot be put in moth balls. Then the machines and their tools are put in storage in the same plant or in a near-by warehouse. The essential thing here is that a package of machines and tools is kept together. That package is tied in with a given building, a given product, and a given management.

THE Ford tank plant is an example. All the machines and tools are being moved to a near-by warehouse, and Ford will keep them in shape. There will be no question here of production being held up because of some critical long-lead-time machine or tool.

Another group of stand-by equipment is that put in central storage depots. The Signal Corps is putting the entire line for producing field telephone wire in such a depot where it can be stored and maintained. It will take a bit longer to get this line back in production, but that is less important on shorter-lead-time items, and the storage is much less costly.

We are doing much the same with machines that are not part of a particular production line. They will be put in central depots until needed.

An important part of this program is the setting up of a Production Equipment Records Unit at Rock Island Arsenal. There, in one central place, a complete inventory is kept of all Ordnance machinery and tools, and this may be extended to include all the production equipment controlled by the Army. The record shows the make, age, capacity, and past use of every single item.

This storing and record keeping is costly, but it is good insurance. The machines and the tools are ready if another emergency arises, and we will know where to put our hands on what we want. Around fifty thousand machines with their tools will come up for lay-away this fiscal year, and we mean to take care of them.

I am sure that in this program you recognize many of the suggestions made in your Reserve Ordnance Production Capacity report. However, that is only a small part of it. What is even more important is the fact that you men represent a pool of production know-how that could not be formed within the Government at any price.

As you well know, production know-how can be gained and kept up to date only by intimate day-to-day contact with production problems. The most brilliant production engineer might soon lose much of his value if he were separated from industry and brought into Government.

We in the Army are in a peculiar type of business. Essentially we are a division of your insurance system. How much and what kind of insurance is a difficult question to answer. Some get along without any insurance at all. Too much insurance on the other hand could wreck us economically and thus destroy our very way of life. The weapon that our enemies want most is a bankrupt America, and the only way for us to beat our enemies is to get more defense for less money.

I do not have to tell you that the men you have sent to Washington are very economy-conscious. They fully realize that Government, like an individual, cannot forever spend more than it takes in.

Obviously the long-range results of such a policy would be disastrous and would jeopardize the very foundation of our way of life. However, it may take years of concentrated effort to undo the wasteful practices and habits that have prevailed for so long.

A free and easy spender is always more popular than a tightwad, and it will take much support from home to have the Government keep on retrenching and retrenching, when spending and spending, although ultimately disastrous, would be much more popular now.

Looking at it from my particular position, you have sent to Washington a group of dedicated men who are giving all they have in the service of our country. However, they can be only as good and only as effective as the support you are willing to give them.

We are very fortunate indeed to have the great industrial leader, C. E. Wilson, heading the Department of Defense. He has surrounded himself with some very outstanding aides, and among them, in my opinion, the greatest is the Secretary of the Army, Robert Stevens.

He has brought to the Army not only his great managerial talents but, what is even more important, a selfless, loyal dedication to our country. He is intensely loyal to the men and women who make up the Army organization. He is sincere, he is humble, he is understanding, he gets things done.

To those of you who have known him for years, this may be old stuff, but for me, working with him has been one of the most satisfying experiences I have ever had.

Looking at it from inside our organizational setup, I am tremendously impressed with how difficult it is to get competent men to serve our country. Of course, in most cases it does involve tremendous sacrifices. But we should and we must find ways to share these sacrifices so that we can induce some of our most competent men and women to serve our country in responsible jobs.

Somehow, we are willing to give of our money but not of ourselves; and yet the very foundation of our way of life is based on individual participation in our Government, be it on local, State, or Federal levels.

We cannot hire "George" to practice our citizenship for us—not any more effectively than we can hire "George" to go to church and pray for us. Citizenship in our country is a very individual matter. We either practice it and retain our way of life or do not practice it and lose our way of life by default.

THERE are many among you who are supplying the Army with various items of material. Some of you have written to me wondering what is going on. Are we again wrecking the Army by cutting the expenditures too far? To that I can give you an absolute and unqualified "No". On the contrary, we are maintaining, and in some cases even improving, our combat readiness. For too many years we have been deluded into thinking that merely spending large sums of money *alone* would buy for us defense readiness. Nothing could be farther from the truth.

Let me give you just one example of how we are obtaining more defense readiness and at the same time spending less money doing it.

Until the advent of the new Administration our entire defense readiness was based upon what may be called a static M-Day concept. In other words, the Joint Chiefs of Staff, after studying the current world conditions, developed an assumption on when and by whom we were likely to be attacked and, evaluating all the factors involved, they set the time for the probable M-Day, the type of military force, the size of it, and so forth, needed to meet the assumed situation.

That being determined, the material requirements were estimated, and we proceeded to build up the necessary mobilization reserves.

These reserves were determined on the standard requirement tables and also upon the availability of each major item involved. For instance, if a particular item required a long lead time to get into production at a consumption rate necessary under the assumed conditions of war, adequate supplies would be purchased and laid in storage to provide for such conditions.

Under this policy when, let us say, M-Day was arbitrarily set for July 1, 1953, we would proceed with full steam ahead to acquire the supplies required by this plan. However, if we did not go to war on that day and if we acquired the supplies required by such a plan, we would stop all buying, disband the production capacity, and wait in a stand-by condition for something to happen.

THERE were many weaknesses to this plan, but the major one was that it was expensive and it did not give us the defense readiness that our type of economy and our way of life are capable of giving us.

The material procured started to become obsolete the moment it was delivered to us. Many of the items would deteriorate with age and become useless, and, of course, the storage of these enormous amounts of materials was in itself very expensive.

By disbanding our production organizations we lost a tremendous amount of mechanical and managerial know-how, thus further lengthening the lead-time requirement. Furthermore, we lost the daily intimate contacts with the men in industry upon whom we must depend for rapid conversion of our economic resources into military strength.

Under our present concept the basic assumptions remain unchanged. The Joint Chiefs of Staff still make their evaluation of the current situation and determine the size and type of military organization to cope with it. Material requirements are estimated the same as before, except that no definite M-Day is set. We work toward it but try not quite to reach it.

In other words, instead of rushing toward meeting our mobilization reserve stock by a certain date and then going out of business, we try to keep the maximum number of organizations in production, and since this reduces the time required to reach full production required under the assumed war conditions, we maintain our defense readiness with a much smaller amount of material on hand.

Whenever we are approaching the set mobilization stock reserve for any given item, we reduce the number of manufacturers producing it and correspondingly increase the mobilization reserve requirement. In this way we are able to provide dynamic defense readiness and take fuller advantage of our industrial potential than the former static plan made possible—and we do it at a much lower cost to the Nation.

I could go on and on with specific cases and examples, but it all adds up to the fact that we are introducing better and more effective controls and better management practices into the Army supply system. However, that is only a part of the story. The Secretary of the Army several weeks ago appointed a committee of five of the most outstanding citizens in our country to review the entire operational setup of our Army.

The purpose of this project is to advise the Secretary of the Army as to the ways and means of strengthening and improving the Army organization in order that we may fulfill more effectively the national-security mission assigned to the Army. In addition to this, each of the technical services is reviewing its functions and ways and means to improve its methods of operation. I have been amazed by the progress that has already been made, but we have a long, long way to go.

The response of our military leaders toward this method of approach has been most gratifying. I have been in intimate contact with the Army for many, many years, but during the past few months I have developed even greater respect and admiration for our military leaders. They constitute one of the finest group of men I have ever had the pleasure to work with. They are loyal, they are capable, they are hard working, and they are sincere.

WE owe them a great debt of gratitude for dedicating themselves to the cause of our national defense. I sincerely believe that much of the criticism that arises when they fail to accomplish the almost impossible stems from a lack of information and understanding of the facts of the situation.

I feel more than ever that our American way of life is the best example of the advantages of the free-enterprise economic and social system. It has produced for us not only the most abundant life that man has ever known at any time anywhere, but it has also developed the inherent talents and potentialities of individual men and women to a degree that has never been dreamed of—and that constitutes our greatest defense weapon, and no potential enemy has any conceivably successful weapon against it.

Over a period of years, various nations with large military establishments have been groaning under the tremendous economic burdens that such a policy has involved. The consequent results have been low standards of life—guns but not butter. Our way of life, on the other hand, tends to develop men of managerial techniques which, when wisely used, permit the most effective utilization of our industrial strength for peace as well as for war purposes.

Rocket Development

The Army's carefully planned, long-range research program is paying dividends in knowledge and experience essential to the production of free-flight rockets and guided missiles

Brig. Gen. H. N. Toftoy

FEW new subjects have excited greater interest or more speculation than have guided missiles. The advent of supersonic rockets has resulted in sensational stories in the press about such things as push-button war, earth satellites, rockets to the moon, and so on.

These extravagant stories are misleading. They result in confused thinking and an erroneous public evaluation of the purpose and progress of the national program.

In order to clarify the picture, let's start with what makes a rocket go. We all learned in school that several centuries ago Sir Isaac Newton evolved a set of laws on motion after being hit on the head by an apple dropping from a tree.

IN his third law, Newton stated that any force in nature is always accompanied by an equal second force which acts in opposition to the first force. In other words, actions and reactions are equal and opposite.

This simply means that when you run, your feet push against the ground while the ground pushes against your feet; a locomotive pulls in one direction while the cars pull in the opposite; and a gun kicks back when a bullet is shot out of the barrel.

Consider for a moment a rubber balloon. If blown up and the stem closed, the balloon lies motionless. But if the stem is left open, the balloon will scoot away. This is because the force of air pressure inside the balloon is exactly balanced in every direction when the stem is closed. But when the stem is open, the force of the internal air pressure, equal and opposite to the force of the escaping air, pushes the balloon forward. Motion is not produced by the jet pushing against the outside air.

A rocket operates on this principle. When rocket propellants are burned in the motor chamber, the products of combustion (hot gases) escape with a high velocity through a nozzle. The equal and opposite force to this powerful jet is what propels the motor and everything attached to it. Since this force is produced inside the motor, a rocket will operate in the empty space or vacuum outside the earth's atmosphere.

The rocket is one of four types of jet propulsion. Before discussing rockets further, let us touch on the other three types.

One of these is the turbojet, used principally for aircraft. A blower-type compressor is rotated by a gas turbine and forces air into a number of combustion chambers where a kerosene-type fuel is injected and the mixture ignited by spark plugs.

The continuously burning gases spin the turbine and provide thrust through the single nozzle. These units are capable of operating at supersonic speed, and are relatively complicated and expensive.

Another type of jet motor is the intermittent-jet or aëropulse engine consisting of a tube with a grill of one-way flapper valves in the front end. Air enters through the valves, fuel is injected, ignited, and exploded.

The increased internal pressure due to the explosion automatically closes the valves and the products of combustion are discharged to the rear through the nozzle—thus producing thrust. This cycle occurs fifty times a second or more.

THE motor will idle when static, but forward motion at normal velocity is necessary to force sufficient air through the valve system to develop propulsive thrust. Therefore, a missile using this motor must be booster-launched at high speed by the use of auxiliary equipment. Speeds developed to date are under 400 miles an hour. It is simple, cheap, and fairly efficient, and is capable of considerable improvement.

The German V-1, which utilized this motor, was very effective. Beginning in June 1944, over 8,000 were launched against England in a period of 2½ months. More than 2,000 V-1's got through the heavy air defenses and reached the London area.

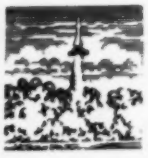
The third type of motor, the ramjet (sometimes referred to as a flying stovepipe), is simply a cylinder which compresses the air through speed in flight, injects fuel into the combustion chamber, and derives thrust from the

General Toftoy conducted the first Allied studies of German rockets after World War II. At present he is director of the Ordnance Missile Laboratories at Redstone Arsenal, Huntsville, Ala.

expanding gases passing through a nozzle.

In the most common designs there is a torpedo-shaped interior section in the center which acts as a damper in the "stovepipe" and reduces the supersonic air flow to the proper velocity and pressure to support combustion.

This power plant is the simplest of all, having no moving parts and is capable of flying at better than four times the speed of sound.



These three types of motors depend on the atmosphere for oxygen to support combustion and therefore cannot operate much higher than aircraft. Of the three, only the turbojet can take off by itself because the others have no air compressor and depend on full flight speed to supply the air required for combustion together with the high-velocity exhaust discharge necessary to produce thrust. For the pulsejet and ramjet an auxiliary launching catapult or rocket booster is required.

The rocket is the only form of jet propulsion which carries its own oxygen and therefore performs with maximum efficiency outside the earth's atmosphere where there is no air resistance to overcome.

NATURALLY, the weight of the oxygen carried by a rocket limits its pay load. In the case of the German V-2, the 10,800 pounds of oxygen carried is 5 times the weight of the pay load. So for some purposes the other types of engines will be more economical.

We generally divide rockets into two classifications—free-flight rockets and guided missiles.

Free rockets were used in warfare by the Chinese 700 years ago. These were similar to our Fourth of July skyrockets. After some improvements, rockets were used by many nations from the fourteenth to the seventeenth centuries. They were immortalized in our National Anthem by the phrase "the rockets' red glare."

But when rifled guns were introduced in 1860, rockets could not compete with the increased accuracy of rotating projectiles and therefore fell into disuse.

The main advantage of rockets over artillery is that no heavy gun or mount is required to shoot them. Only a lightweight open tube or a pair of hooks—like a bomb rack—is used to aim and launch the small free rockets.

In this class we have such rockets as the bazooka which was developed by this country. The bazooka gave the foot soldier for the first time a weapon with which he could singlehandedly destroy a tank.

Then there are the field-artillery-type rockets which supplement rather than supplant conventional artillery. Multitube launchers, capable of firing as many as sixty rockets singly in cascade or all at once, were installed on tanks, vehicles, and boats and used to saturate area targets such as beachheads, strong points, and service installations.

The free rocket is a quite simple device. It consists of a bullet-shaped housing containing a war head and fuzes, a combustion chamber within which is also carried the propellant in solid form, and a propellant igniter. The motor terminates in a nozzle to increase the velocity and hence the power of the jet.

These rockets are stabilized in flight either by fins in the same manner as an arrow, or by spin imparted by the jet gases being deflected through a ring of canted nozzles instead of being discharged directly to the rear through a single nozzle.

The guided-missile field includes pilotless aircraft, liquid-fuel rockets, and ramjets in various sizes, shapes, and combinations. Some are winged, others not. Some are steered from outside sources, some automatically controlled by devices within the missile, but all are crewless, one-way jobs.

To give some idea of what these are like, here is a description of a large, liquid-fuel supersonic rocket of the V-2 type:

Imagine a cigar-shaped airplane fuselage fifty feet long and five feet in diameter, sitting vertically on its flat end. At the top or pointed end is a ton of high explosive with the necessary fuzes to detonate it on impact.

Below this conical warhead is a control compartment containing the automatic pilot and "brain" elements of the control system including various electronic devices, gyroscopes, and time and altitude mechanisms.

Beneath this compartment are the large propellant tanks—the upper one containing 1,000 gallons of alcohol and the lower one 1,000 gallons of liquid oxygen. These two fuels weigh almost ten tons, and they have to be pumped into the combustion chamber of the engine in one minute. For this purpose a 580-horsepower steam turbine is provided.

Steam to run the turbine is generated in a separate chamber by the reaction of hydrogen peroxide and sodium permanganate—two more propellants, two more tanks.

AROUND and below this steam plant is a maze of pipes, with pneumatic, hydraulic, and electrical operating gear. Below this "plumber's nightmare" is the rocket engine into which eighteen groups of nozzles inject alcohol and liquid oxygen properly regulated.

Because the high-temperature, high-velocity gases would quickly burn through the metal walls of the combustion chamber, it is necessary to cool them by circulating the alcohol through a jacket around the motor.

Externally, there are four large tail fins to provide stability of the rocket during flight. There are two sets of control vanes. One set, made of carbon, operates in the jet and steers the missile during take-off when the velocity is low. The other set, on the rear end of the fins, operates in the air stream after the missile has reached high velocity.

The desired range and azimuth are preset in the missile before it is launched. The launching is awe inspiring. As full thrust is applied, a tremendous jet of flame slowly pushes this towering, 14-ton missile vertically upward, accompanied by a reverberating and stupefying roar. The rocket gains speed rapidly and gradually inclines on its course, and the fuels are automatically shut off when the missile has reached the desired velocity. At this point it is traveling at approximately 3,500 miles an hour.

Above the stratosphere its center of gravity follows the trajectory—but the missile itself actually tumbles as it coasts through the rarified upper reaches of the atmosphere where the fins have no effect. As it reënters denser air on descent, the fins again stabilize the missile on a normal nose-first course.

AIR resistance slows it down to about 2,400 miles an hour before it reaches its target. The air friction heats the skin on the nose to a dull red.

The Germans first produced the V-2, and we have capitalized on their years of research and millions of dollars of expenditures by carrying on where they left off.

One of the most difficult engineering problems which we face in the development of guided missiles is the design and fabrication of the guidance and control system. A guided missile is a relatively expensive munition. To make their use economically feasible, every round must prove effective and strike as close to the center of the target as we can make it.

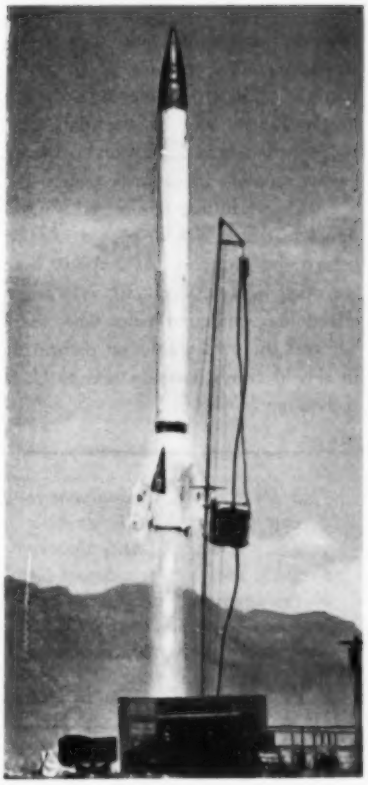
How can this be done? There are several types of guidance systems which can be used either by themselves or in combination.

First, we can carry in the missile devices which enable it to compute where it is in relation to a precalculated course and automatically apply steering orders to put it back on the true course. This requires extremely accurate mechanical and electronic devices built into the missile; call it a "robot pilot" if you wish.

This "automatic pilot with a brain" must be compact, lightweight, and rugged. Such a system is known as "preset" and is suited generally to the surface-to-surface missile where the target is fixed.

Another means of doing the job is to control our missile from the ground by knowing precisely where it is at all times and predicting where the target will be. We can then send electronic commands by radio or radar techniques to the missile to enable it to correct its course so as to hit the target.

There are other ways of doing the job. We can design the missile to fly



The Viking high-altitude research rocket roars into flight at White Sands, N. Mex.

automatically in an electromagnetic beam—while we keep the beam pointed on the target, like an invisible searchlight. This is the beam-rider method, used principally in the field of anti-aircraft defense.

There are also systems in development which cause the missile to orient itself automatically with respect to stars or other known reference points such as radio stations and steer itself along the prescribed course. This is known as the navigational system.

ANOTHER is the homing system in which missile-borne devices identify the target by heat, light, radar, sound, or other means and correct its flight path to hit the target. Generally speaking, homing, due to its limited range, has its best application against near-by targets or for final corrections at the terminal end of a long trajectory.

Some missiles, particularly the long-range ones, will be guided by a combination of two or more of these systems. The technical requirements in developing these complex systems include more powerful and precise means of electromagnetic propagation, increased sensitivity and reliability of electronic components, lighter and smaller sources of power, more accurate gyros and accelerometers, foolproof recognition of targets, etc.

You may remember that in 1949 the press carried the story about the 2-stage liquid-fuel rocket launched by the Ordnance Corps at White Sands Proving Ground, N. Mex., which attained an altitude of more than 250 miles.

At the peak of its flight it was higher above the earth than any man-made object had ever gone before and was, for all practical purposes, outside the earth's atmosphere.

THIS record-breaking missile was made up of a captured German V-2 rocket with its nose modified to accommodate the second stage, which was an American-designed liquid-propellant rocket known as the Wac Corporal.

The objectives of the project went far beyond the setting of new altitude and speed records. Although it is recognized that the multiple-stage principle offers the most efficient means of attaining great ranges or altitudes, no one previously had assembled and launched a 2-stage missile. There were skeptics. The primary objective of the flight, therefore, was to obtain information on the separation and ignition of the second-stage rocket in highly rarified air, and also on the stability of the second-stage missile at extremely high velocities and altitudes. A secondary objective was to obtain aërodynamic data at Mach numbers above those which had previously been attainable.

The first full-powered flight was entirely successful. Separation occurred at approximately 20 miles' altitude where the air was really thin, and the Wac Corporal traveled upward with a velocity of more than 5,000 miles an hour. The entire flight from launching to impact lasted approximately twelve minutes, during which time the earth was rotating constantly under the missile, so we had to allow a correction of many miles to compensate for the earth's travel.

The success of this flight marked an important forward step in the history of rocket development. In addition to opening up for scientific research entirely new and unexplored regions of the upper atmosphere, the results obtained from this and similar flights will prove to be of significant value to the designers of long-range missiles of the future.

From the preceding discussion it is obvious that experts in electronics, aërodynamics, physics, chemistry, meteorology, mathematics, and many other fields of science are required to collaborate as a team in the development of guided missiles.

NO other single development is as complex or as difficult as a guided missile. Brand-new contributions representing real advances in many fields of science are required to solve the various guided-missile problems.

For example, chemists are working on suitable new fuels of greater energy, and metallurgists are developing materials capable of withstanding the high-temperature and erosion effects of high-velocity jet gases; electronic experts are designing control, guidance, and telemetering systems.

The Ordnance Corps is looking to industry for the solution of these problems as well as many others, including precision gyroscopes, lightweight construction of tanks and structures, high-performance fuel systems and motors.

If the program is so difficult technically and so costly, why do we at this time allocate the effort we do to it? Basically, supersonic guided missiles will become extremely important weapons because (1) once launched, their great speed makes them invulnerable to any known countermeasure, (2) they are all-weather weapons not limited as are aircraft, and (3) they will deliver highly destructive payloads including atomic war heads in appropriate sizes to targets without risking the loss of highly trained men.

There are other reasons, including the fact that conventional antiaircraft guns cannot combat modern high-altitude, high-speed bombers as effectively as can rockets and guided missiles. Also, in land combat the use of all-weather guided missiles as an extension of artillery reaching out to much longer ranges will be essential, especially when a numerically superior enemy employs mass-attack tactics.

At the beginning of the Army Ordnance program back in 1943, two years before the German V weapons were launched against England, it was realized that guided missiles were feasible and that we would be pioneering in a field almost entirely new to U. S. technology.

"No other single development is as complex or as difficult as a guided missile. . . . The Ordnance Corps is looking to industry for the solution to problems including precision gyroscopes, lightweight tanks, high-performance fuel systems and motors."

Therefore, a carefully planned, long-range research and development program was initiated with emphasis placed on basic research in order to build up the knowledge and experience which would insure successful development of satisfactory guided-missile weapons at a later date.

We utilized, under contract, some of the most capable civilian scientific and industrial organizations available, so that the best talent in the country would be engaged on our projects. The program proceeded satisfactorily in a step-by-step approach. We were learning to walk before we ran. It was a sound program and is now paying dividends.

The national guided-missile program consists of the coördinated efforts of the Army, Navy, and Air Force. In order to prevent unwarranted duplication of funds and scientific manpower, these three programs are subject to continuous review and coördination at the level of the Secretary of Defense (that's the top level) through the Office of the Assistant Secretary of Defense for Research and Development.

This coördination does not preclude having more than one project with the same objective, but the technical approach must be different. There is a full free exchange of technical information between the military services—no "working behind the barn."

Just how important is this expensive guided-missile effort to the country? In a recent article the then Army Chief of Staff, Gen. J. Lawton Collins, said:

"WE have also made genuine progress in our development of guided missiles for the air defense of the United States. I recently visited White Sands and saw some of the firings of our Nike missiles against aircraft at ranges and altitudes which were trying to evade the missiles.

"They are living up to our most optimistic expectations. When they are in the hands of our units, our antiaircraft defense will be many times tighter. . . .

"Closely allied with our progress in atomic artillery is our advance in guided missiles. These missiles can carry either conventional explosives or an atomic war head. Their all-weather characteristic is most vital to Army operations in the field, and their great range makes them capable of hitting any part of an entire corps front. Recent tests indicate that we will have such missiles in the not-too-distant future. The development of guided missiles, particularly when combined with our progress in atomic weapons, is a tremendous step toward a truly modern Army ready to contribute a formidable defense to the free world."

THERE are many advantages to this Nation besides defense. The frontiers of science are being advanced. The research being carried on as part of the guided-missile program is resulting in greatly improved materials and techniques which will benefit industry and be reflected in improved products of interest to us all.

This work is too important for the security of this Nation to be permitted to become routine. We are making excellent progress, but it is essential that the Army, Navy, and Air Force, working together on these developments, should continue to receive the full support of the American people.

Management-Labor Relations

The valuable technique of balancing coöperation and teamwork between supervisors and workers is a greater asset to maximum production than superior technology or modern mechanization

J. E. Trainer

AMERICA has served as the arsenal of democracy in two world wars, and we have seen it vividly demonstrated during and after these wars that slave labor cannot compete with free labor either in the production of munitions or of consumer goods.

Our country stands today as the colossus of production—a wonder of the modern world. It has become the mecca for manufacturers of other countries. Many pilgrimages have been made from afar by teams of experts who sought the secret of American productivity.

The findings of missions from various countries are similar to a startling degree. Those of the British experts in 1950 and 1951 are typical. Chief among the reasons for America's superior productivity, according to the members of this team, are:

(1) A competitive spirit, extending to workers as well as to management; (2) new ideas—their origin and acceptance at all employee levels; (3) team spirit; (4) a greater use of unskilled labor by job breakdown; and, (5) mechanization.

THE startling thing about all these surveys by foreign experts is that they give more credit to American labor attitudes and management techniques than they do to technology.

If our friends from abroad have appraised correctly the reasons for America's superior productivity—and I am sure they have—it becomes apparent that good management-labor relations are the key to maximum production.

Mr. Trainer is vice-president of the Firestone Tire & Rubber Company, Akron, Ohio, and a member of the Board of Directors of the American Ordnance Association.

A moment ago I mentioned that we Americans have come to the belief that slave labor cannot compete with free labor. I share that view. However, it is also my opinion that a dictator can get more output per man from people who have never known freedom than we could get from Americans if we were to try a dictator's methods of forcing labor.

I would judge that planning for an all-out war must certainly involve planning for some kind of manpower controls.

The conscription of manpower for industry might range anywhere from total to slight; from the actual drafting and assigning of workers to jobs in the order of their importance on the one hand to the types of controls we had in World War II on the other.

As long as men are drafted to die in battle, there can be no valid moral objection to the principle of total conscription. As a practical matter, however, in the interest of maximum output and quality of product, I sincerely hope that any manpower controls which necessity may force upon us will be designed to give some leeway of choice to the individual.

The basic principles of management-labor relations should not, in my opinion, be any different whether workers have union representation or whether they do not. Of course, union relations are a part of employee relations. In many instances they introduce complicating factors as, for example, where employers or employees or both may be caught in a cross fire between competing unions or factions within one union.

OTHER complicating factors commonly found in dealing with some labor unions include a resistance to improved technology; the contention that seniority alone—without regard to ability—shall govern promotions; and insistence that *all* dealings with management on behalf of labor shall be through union representatives.

Some unions would even go so far as to deprive employers of the right to choose their own employees.

To the extent that management agrees to any such union demands as these, it thereby agrees that it will consider labor *en masse* instead of as individuals. And when you cease to think of employees as people—as individuals with varied temperaments and abilities and personal problems—you tear out the foundation from under sound employee relations.

Despite such complicating factors, the same *principles* that apply to dealing with employees direct should also apply to dealing with them through union representatives. The *practice* of

these principles is more difficult because of the injection of a third party—the union.

Most Firestone plants operate under contracts with labor unions. We have been successful in maintaining the principle that any employee may first discuss any complaint he may have directly with his supervisor before making it a subject of contract grievance procedures. Any man may, if he wishes, use his union representative for this purpose, but he is not compelled to do so. He is at liberty to discuss his problems directly with his supervisor.

We believe it infinitely better to get a complaint firsthand than to have some second- or thirdhand explanation of what is involved. We believe it better to handle that complaint promptly on a man-to-man, informal basis than to have it processed through grievance procedures provided for in our contracts. A complaint so handled—informally between a supervisor and a workman—is an act of coöperative team play that builds good will.

Production is the creation of material things of value. It is these "things" or "products," available in quantity at reasonable prices, that set our American standard of living apart from that of the rest of the world. In terms of munitions, it is these "things" that have multiplied the strength of our fighting men.

If he is to stay in business in our dynamic American economy, every manufacturer must strive constantly to make his product better, price it lower, and sell more of it. He must see that balanced justice is accorded the customers, the workers, and the owners.

STATED simply, our average standard of living might be determined by dividing our total production by the number of people in the country. Regardless of differences of opinion about how the distribution is to be proportioned, it is obvious that improving the *average* can come about only through increasing the pool of goods and services to be divided.

Therefore it is certainly in the interest of all that each individual make his contribution to the pool as large as it reasonably can be made.

To my way of thinking, anything that stands in the way of an individual's opportunity to make his full contribution, within the limits of healthful practice, is both wasteful and antisocial.

Therefore, we must resist "featherbedding" in all its forms. Incidentally, you probably think, as most people do, that "featherbedding" is a practice confined to labor. I consider that it is also practiced by European-type trusts or "cartels" when they fix prices and quality and when they assign exclusive sales territories so as to avoid competition among their members.

I consider that "featherbedding" is practiced by Government when any official's family or political henchmen go on Government pay rolls for performance of mythical or nonessential duties; or when, in times of emergency, inadequate attention is given to the most effective utilization of skills; or when bureaus, departments, or offices established for emergency purposes remain in existence beyond their useful life.

Labor has rapidly developed well-defined "featherbedding" techniques over the past several years. Chief among them is refusal to use machines that afford faster output; or, alternatively, refusal to operate such machines efficiently.

"Featherbedding" is repugnant to Americanism, whether practiced by Government, capital, or labor. The ends are the same—somebody has a "soft snap," or gets something for nothing while the consuming public foots the bill or while the price of a needed commodity is driven beyond the point where many would-be customers can afford it.

Actually, the basic interests of business and labor are identical. They require us to make the right product, of the right quality, to sell at the right price, and to deliver it at the right time. The customer bears the cost, and he must be able to afford it.

Management must, therefore, insist upon an honest day's work in return for a fair day's pay.

Prior to the introduction of assembly-line techniques, the average worker, either alone or as one of a small crew, made a complete product. He had the satisfaction of accomplishing a complete piece of work; of pride in his skill and reputation as a craftsman; of pride in the article which he made. He knew its purpose, its abilities, and its limitations. He was a qualified and conscientious inspector of his own work.

Today, the vast majority of production operations are routine. They are limited to a single part or a single assembly operation. Instead of being an important man on a small crew, or doing a complete job himself, a worker may be one of a thousand on identical jobs in his department.

Forty years ago, when the owner of the typical factory walked in the door, he probably said good morning to every one in the plant. He knew his employees by name and had time to talk with each one of them occasionally, to ask him about his family, and to show interest in him as an individual instead of as one unit of a vast item of production cost described as "labor."

SINCE then, as businesses have grown, the owners have had to spend more and more time in the office. The number of employees in the average plant has multiplied to the point where it may be impossible for any one man to be acquainted personally with all of those who work for him.

Today's conditions, therefore, demand a different method of bridging the gap between top management and the man on the machine.

More often than not, an informed worker is an interested worker. There are various means of keeping employees abreast of developments that affect their company and their jobs. Company publications, or house organs, are one method. Special reports or letters to employees are another. Providing them copies of annual statements is another. These are all good media.

I believe that an employee whose livelihood depends upon his job is as fully entitled to know the results of his company's operations as is the average stockholder.

The most important method, however, and one for which there is no adequate substitute, is by word of mouth in daily man-to-man contacts of

supervision with the people under them.

The only way to prevent unwarranted suspicion about the effect of new ideas on jobs is to give full and complete information about them. An incomplete explanation isn't good enough.

By way of illustration, I would like to tell you about our experience with the installation of statistical quality control—or "SQC" as we call it in Firestone plants.

SQC is simply a method for recording spot checks on quality of a part or product made by a given crew or individual.

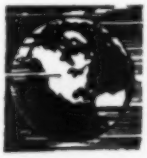
THE experience of our Memphis plant is typical. When this plant first started on its job-by-job installation of SQC, a brief meeting would be held with the workmen affected, either at their machines or in the department offices, to explain the program and the charts. The program was accepted—but indifferently. So we went a step further. And, from our Memphis plant report, I quote:

"Beginning in November, a series of quality meetings with workmen and supervisors of various production departments was conducted by the SQC department.

"In contrast to earlier hasty explanations in the factory or in factory offices, these meetings were planned and prepared for in advance. They were held in the main conference room, and the employees were paid for the time spent in the meetings. Among the points emphasized in these meetings were: the general customer demand for better quality due to the approach of a buyer's market; the fact that the job of every person in the organization depends on satisfied customers; the fact that quality workmanship protects jobs, while poor work endangers them—in short, that the daily bread of every employee depends on the quality of product turned out.

"The responsibility of the workers for customer satisfaction was further emphasized by display and discussion of the adjustments made with customers during the previous year because of defective workmanship. It was then pointed out that the defects responsible for larger percentages of the adjustments were given the most points in the rating charts.

"The positive approach to quality was emphasized by pointing out that the SQC program is designed as much to give credit for excellent work as it is to point out poor work. This last point has since been further emphasized by letters of commendation sent to workmen with the higher ratings.



"The charts were carefully explained along with all details of the program applying to their operations, and the people were invited to ask questions and make suggestions. The participation by the workers was good, and several worth-while suggestions were made."

Here, in this one program, you see illustrated the difference in degree of acceptance and coöperation that can be expected when employees are given a hurried explanation of a new program, on the one hand, and when they are given the full treatment on the other.

HAD we made no attempt at information, you may be sure the SQC program would have been completely ignored by the men whose work it was designed to improve. So information is very important.

Employee relations include many things: recreation programs, plant newspapers, attractiveness of plant surroundings, and so forth. But when you get right down to rock bottom—to the basic facts of life as they apply to employee-labor relations—quality and training of supervisory personnel are paramount.

A good labor-relations program can be built solely upon supervision. And, regardless of all the other trimmings or devices that may be used, no management-labor-relations program will succeed if it ignores the relationship between a man and his immediate boss.

I mentioned that today's conditions demand a bridge, unnecessary forty years ago, between top management and the man at the machine. The supervisor must be that bridge.

Recently the University of Michigan began a study of several businesses in different types of industry to try to find out just what it was that distinguished highly productive groups of workers from groups with low records of productivity.

I believe the survey is, as yet, too small in coverage to be called conclusive. But there is one significant factor which was found in every single one of the high-productivity groups. That factor was supervision.

The supervisors of the high-productivity groups spent more of their time in planning their work and less time on routine work. They spent more time on the floor with their men. They were keenly interested in getting out maximum production. They took immediate action when employees would report machine breakdown, material shortages, or unsatisfactory materials. They encouraged employees to offer suggestions and helped them to develop their suggestions into workable improvements.

What, then, should industry seek in its supervision?

First, I think industry should seek men of good character—men who are worthy of the respect of their fellow men.

A supervisor must, of course, have a thorough knowledge of the jobs under his direction. He must know the provisions of any union contract affecting his department, and he must know company policy.

Obviously, then, his company must have a training program for him—formal or informal as the case and size of the business may require. But this training program must be a regular, continuing, repetitious part of his education. He must be kept up to date on company policy and brushed up to alertness on general principles and practices.

I TRY to impress upon members of our supervisory team whenever I talk with them that the desire of men to coöperate with one another is as old as civilization itself. We see that desire reflected in popularity of sports that involve team play.

In the first place, we must remember that coöperation is not a one-way street. A supervisor owes it to every new em-

ployee who reports to him to coöperate with him by giving him the facts about his job and an outline of the place his job holds in the general scheme of things in the plant.

After this has been done, and before he leaves an employee on a job new to him, I like to have our supervisors say in effect, "I hope you will like it here and that you won't hesitate to ask me for any information you may want from time to time about your job or the plant in general."

After that, for as long as it requires our new friend to become a smooth-working member of the team, the supervisor should personally follow up on his progress with sufficient frequency to insure that he makes good and likes his job.

A good supervisor is a good listener. He has a nice sense of balance between being "wishy-washy" on the one hand, and pig-headed on the other. If he knows the answer, he should in most instances try to handle any problem presented to him without delay. He should explain the underlying reasons for handling it the way he does.

If he has any doubt whatever about the facts or the proper answer, he should take the problem under advisement, think it through, discuss it with his superior, and then at the earliest possible moment give an appropriate answer and explanation.

A SENSE of balance is essential in a supervisor. If a man can be impartial without being cold; friendly without being chummy or showing favoritism; if he can be open-minded without wavering like a reed in the wind; if he can recognize his own mistakes as well as the mistakes of others; and if he can help accomplish corrections of mistakes harmoniously and without recriminations, then he can smooth his way over many a rough road and win and hold the respect of the people who work under him.

A good supervisor gives credit where it is due and does not seek to cut for himself a slice of credit for ideas offered or developed by the men under him. The only men who are productive of new ideas are those who have confidence in the integrity of their boss.

The supervisor who can inspire mental coöperation as well as physical effort is many times more valuable than a man who may be more ingenious as an individual but who does not have the confidence of the men under him.

It is very easy, when a man finds himself in a tight corner and is at a loss for a ready answer, to hedge and make promises for the sake of temporizing. A supervisor must fix solidly in his mind this motto—"Don't promise what you cannot perform and don't fail to perform what you promise." It takes a long time to gain the confidence of others. It takes only one broken promise to tear down a foundation of confidence that has required years to build.

And just one case of unmerited "appeasement" by a supervisor is likely to be construed as discrimination, to cause dissension, and to start a chain reaction of exceptions to sound practices.

Self-control and a friendly attitude will do much to win and hold the respect of any one. At some time or another we all say something that might be interpreted in a way different from our intention. A word misspoken can't be recalled if it's spoken in anger. It may be interpreted differently if it's spoken in a friendly manner.

Another important guiding principle for supervisors should be this: he should talk more with his people on subjects that represent common ground, or mutual interest, than he does on points of controversy.

For example, safety programs and employees' suggestion programs serve useful ends in themselves. In addition, they have a very definite employee-relations aspect.

A good safety program is concrete evidence of management's interest in the welfare of the individual.

A suggestion plan fosters a sense of belonging to the team in a more important capacity than the individual job may permit.

Both the British industry team's report on United States productivity and the University of Michigan's survey mention origination of ideas as a characteristic of high-production workers.

"A good labor-relations program can be built solely upon supervision. And, regardless of all the other trimmings or devices that may be used, no management-labor-relations program will succeed if it ignores the relationship between a man and his immediate boss."

Obviously, a sound employees' suggestion program is an important morale builder.

And both programs—safety and suggestion—foster a closer relationship between supervision and workers by affording them a common meeting ground outside the regular field of production—a meeting ground to further the welfare or ideas of the employees themselves.

These principles, adopted both in spirit and practice by the supervision of any average group of American workers, will make that group more highly productive. They will do more than that. They will promote a confidence in management that will lessen a tendency to resist the technological changes that industry must rely upon for ever-increasing productivity per employee.

Thus, the basic principles of a sound management-labor-relations program are simple. Their practice, on the large scale required in our industries today, is sometimes difficult because of the vagaries of human nature.

BUT industry can have highly productive workers if it will choose high-caliber supervisory personnel, train them adequately, and impress upon them constantly, "not once and again, nor again and again, but again and again and again," these simple truths:

Companies are not brick and mortar. Companies are people. Coöperation and teamwork of the kind America needs cannot be bought with gold nor forced by the whip of a dictator. It has only one price—a like amount of the same.

Editors' Note.—This article is based on a speech given recently by Mr. Trainer before the Industrial College of the Armed Forces, Washington, D. C.

National Security

The Nation's leading civilian and military defense officials stress national security in an age of peril at the Annual Industrial Preparedness Dinner Meeting in New York City

WEDNESDAY, December 2, 1953, was an historic day in the annals of the American Ordnance Association:

The annual meeting of the Board of Directors of the American Ordnance Association was held that morning at the University Club, New York City. Lieut. Gen. Levin H. Campbell, Jr., president of the Association, presided. The following members of the board and officers of the Association were in attendance:

R. L. Biggers, Detroit; W. H. P. Blandy, New York; Donald F. Carpenter, Wilmington; William W. Coleman, Milwaukee; C. Stewart Comeaux, Oklawaha, Fla.; Herbert A. Gidney, Pittsburgh; R. E. Gillmor, New York; E. R. Godfrey, Detroit; Stanley C. Hope, New York; C. Jared Ingersoll, Philadelphia; K. T. Keller, Detroit; Harvey C. Knowles, Cincinnati; F. H. Payne, Springfield, Mass.; Louis Polk, Dayton; John Slezak, Sycamore, Ill.; J. E. Trainer, Akron; Daniel J. Martin, Houston; John M. Olin, East Alton, Ill.; John S. Pfeil, Boston; William J. Rushton, Birmingham, Ala.; John Ross Delafield, New York; James D. McIntyre, Washington, D.C.; Henry N. Marsh, Wilmington; Leo A. Codd, Washington, D.C.; Florence G. Ferriter, Washington, D.C.; Roger E. Lewis, Washington, D.C.; Burton O. Lewis, Washington, D.C.; and J. M. P. Wright, Washington, D.C.

THE following resolution memorializing the life and work of Col. Henry Parsons Erwin, the late treasurer of the Association, was unanimously approved:

"The American Ordnance Association records with deep sorrow the death, at Washington, D.C., on June 3, 1953, of its distinguished treasurer, Col. Henry Parsons Erwin, a founder of the Association in 1919 who served it faithfully and zealously in many ways throughout the following thirty-four years.

"Soldier, financier, economist, and patron of the arts, Colonel Erwin served as associate editor of ARMY ORDNANCE, the journal of the Army Ordnance Association, when that publication was established in 1920. He became assistant treasurer of the Association in 1944, treasurer in 1946, and a director of the Association in 1947. These later offices he filled with painstaking attention and outstanding success. All this service to the Association throughout the years was without financial recompense and often at personal inconvenience.

"Colonel Erwin served with distinction as an officer *(Continued on p. 601)*

Among those at the speaker's table at the Industrial Preparedness Dinner Meeting were, left to right: Vice Adm. George F. Hussey, Jr., president of the New York Post; Adm. Arthur W. Radford, Chairman, Joint Chiefs of Staff; Lieut. Gen. Levin H. Campbell, Jr., A.O.A. president; and the Hon. Charles E. Wilson, Secretary of Defense of the United States.

THE SECRETARY OF DEFENSE ADDRESSES THE AMERICAN ORDNANCE ASSOCIATION

THE members of the American Ordnance Association, many of whom are here tonight, are unique. They can be classified into three broad groups: (1) those who are active in our military establishments, (2) those who are in the Reserve forces, and (3) civilians who are interested in developing and producing superior ordnance for our country's needs.

It is a typically American type of organization. There is nothing compulsory about it. It is completely a voluntary organization. It recognizes our country's need and is willing to coöperate and help take care of that need. It is a particularly worth-while effort, since we realize that we are living in an age of peril—no particular day of maximum danger but a period in the history of the world where our Nation, if it is to remain free, must be strong.

The Communist threat to our country is really a 3-pronged threat. It is in the ideological area where they claim their system is a superior system. They can't make it quite stick because it can't stand competition. That is why the Iron Curtain exists, but nevertheless that is the propaganda threat.

It is a threat in the economic area. They are convinced that free men will be so individually selfish that they will not be able to run a sound economy over a period of years; that it will have great periods of unemployment and hardship. They are trying to upset the economy in all kinds of devious ways, and it is a challenge to the free world to keep that economy sound.

The third threat is an outright military threat—a threat where, if power vacuums exist, they may suddenly move in and through force advance their theories. Conversion by the sword, unfortunately, is nothing new in the history of the world, but it has never been successful.

In the meantime the problem of America is to stick to our free institutions and our firm beliefs in the things that have made our country great; to promote the successful economy of our country, where we raise the standard of living of people year by year, and avoid the hardship of unemployment, speculation, and abuse of credit.

We must also keep sufficient military strength in being and sufficient reserves, both in capacity to produce and in manpower, so that the Communists will not be tempted to what they may think would be an easy victory.

You gentlemen are contributing much in helping us maintain that capacity to produce—and to produce efficiently at low cost.

—Impromptu remarks of Hon. Charles E. Wilson, Secretary of Defense, after receiving the American Ordnance Association's Crozier Gold Medal at the Waldorf-Astoria, New York City, on December 2, 1953.

of the Ordnance Department of the United States Army in the First and Second World Wars. In 1946 he was awarded the Association's Crowell Gold Medal for meritorious Ordnance service.

"The American Ordnance Association, in recording these sentiments, is mindful of Colonel Erwin's important part in carrying forward the national-defense objectives of the Association and the sterling contribution he made to this patriotic endeavor. The Association directs that this memorial be spread upon its records and that a copy be presented to his family with expressions of sympathy for them and of abiding admiration for Colonel Erwin, his life and work."

THE president welcomed the following new members of the Association's governing body: Stanley C. Hope, president of the Hartford-Springfield Post and president of Esso Standard Oil Company, to serve as a director to December 31, 1954; and Maj. Gen. James D. McIntyre, U.S.A.F., Retired, to serve as treasurer of the Association until December 31, 1954.

The president also welcomed Capt. J. M. P. Wright, U.S.N., Retired, formerly of the Navy Bureau of Ordnance, as staff consultant for Posts and chapters at national headquarters.

Reports for the first ten months of 1953 were presented and discussed at length on the following topics: (a) financial operations, (b) membership and meetings, (c) publications, (d) Technical Divisions and Committees, and (e) Post and chapter activities.

Special committees were established, the personnel of which will be selected by the president of the Association to study and report on the following: (a) reserve ordnance technical manpower, (b) Army organization from the viewpoint of ordnance preparedness, (c) Navy organization from the viewpoint of ordnance preparedness.

The board meeting was followed by a luncheon meeting of the Association's Council which was held at 12:30 in the Council Room of the University Club. The presiding officer at the luncheon meeting was General Campbell who relinquished the chair to Colonel Coleman, chairman of Council, for a brief business meeting.

General Campbell congratulates Secretary Wilson.

CITATION ACCOMPANYING THE CROZIER MEDAL

"The American Ordnance Association salutes Charles Erwin Wilson, Secretary of Defense of the United States, for his leadership in American industry, his contribution to the design and production of American armament in time of emergency, and his patriotic service in the high position he now holds.

"As head of one of the Nation's greatest producers of peacetime goods, Mr. Wilson directed the production of vast quantities of weapons and other military supplies during the Second World War, such as no other period in all history has ever witnessed.

"In addition, as a student of military industrial affairs, he pioneered in his advocacy of dual-purpose plants for the production of peacetime goods and the simultaneous readiness to meet wartime needs.

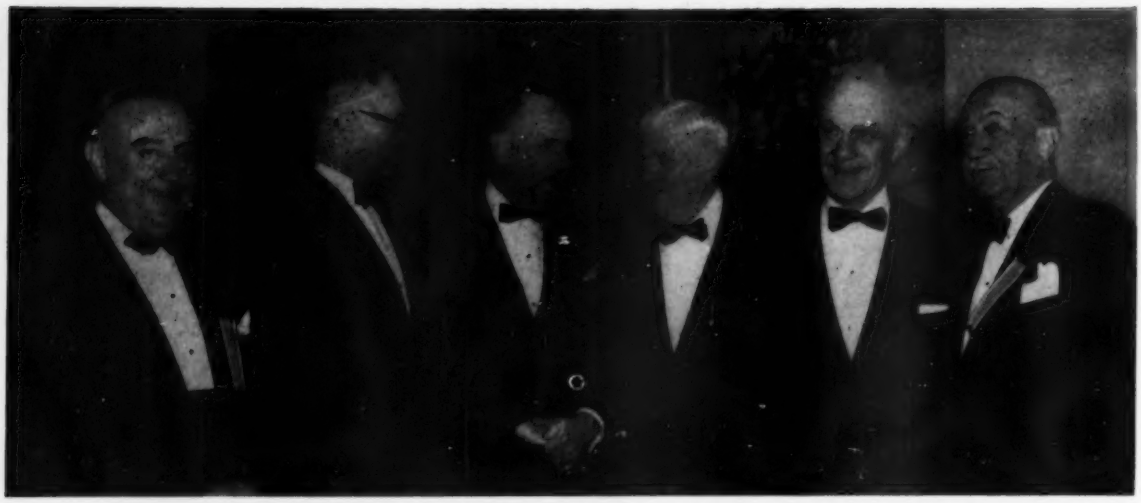
"As Secretary of Defense, at great personal sacrifice he brings to the vast military, naval, air organizations of our country the practical leadership—the goal of which is a strong defense establishment of greatest power and of lowest cost—characteristic of American progress through the years."

COLONEL Coleman announced the election of the following members-at-large of Council for 1954: Joseph L. Auer, New York; G. M. Barnes, Osterville, Mass.; H. G. Batcheller, Pittsburgh; Irving A. Duffy, Detroit; E. B. English, Peoria, Ill.; Robert C. Enos, Coraopolis; Britton L. Gordon, Grand Rapids; G. M. Greenwood, Richmond, Calif.; Carl S. Hallauer, Rochester, New York; John M. Hancock, New York; Arnold Hanger, New York; Walter N. Howley, Morton, Pa.; Roy T. Hurley, Wood-Ridge, N. J.; John C. McHannan, Cleveland; Ernest A. Merklein, Shreveport; E. W. Miller, Springfield, Vt.; William H. Mitchell, Cincinnati; Clyde H. Morgan, St. Louis; Thomas E. Murray, Sr., Washington; W. C. Pew, Philadelphia; J. Carlton Ward, Jr., New York; T. J. Watson, New York; W. A. Wilson, Los Angeles; H. T. Bodman, Detroit.

Colonel Coleman also announced the reëlection of the following national directors of the Association for 4-year terms beginning January 1, 1954: Mr. Biggers, Colonel Gidney, Mr. Gillmor, Mr. Knowles, and Mr. Polk.

The president then introduced the Hon. H. Struve Hensel, General Counsel, Department of Defense, who presented a timely analysis of the organization of the Department in accordance with the studies of the Rockefeller Committee.

Mr. Hensel, a close associate of the



Attending the reception before the dinner were, left to right: Maj. Gen. R. L. Maxwell, Vice Adm. George F. Hussey, Jr., Lieut. Gen. Levin H. Campbell, Jr., Secretary of Defense Charles E. Wilson, Brig. Gen. Joel Holmes, and Maj. C. Stewart Comeaux.

late James Forrestal, first Secretary of Defense, rendered outstanding service to the Navy during the Second World War and is a leading proponent of national security.

Following Mr. Hensel's address the meeting of Council was adjourned.

THE Annual Industrial Preparedness Dinner Meeting was held in the Grand Ballroom of the Waldorf-Astoria that evening at which the guests of honor were Secretary of Defense Charles E. Wilson, whose address is published on page 600 of this issue, and Adm. Arthur W. Radford, U.S.N., Chairman of the Joint Chiefs of Staff, whose address is published on page 570.

Mr. Wilson was awarded the Association's Crozier Gold Medal and Admiral Radford was awarded its Blandy Gold Medal. Both awards were for distinguished service to the national defense of the United States.

Vice Adm. George F. Hussey, Jr., president of the New York Post., presided at the Waldorf dinner meeting, and the invocation was given by Capt. Joshua L. Goldberg, U.S.N., Chaplain, Third Naval District. There were 1,876 members and guests present at the dinner meeting.

In announcing the winner of the James L. Walsh essay contest for 1953 to the more than 1,800 members of the A.O.A. assembled in the grand ballroom of the Waldorf-Astoria, Leo A. Codd, executive vice-president of the A.O.A. said:

"Early this year the American Ordnance Association established the James L. Walsh Memorial Essay Prize in tribute to the memory of Col. James L. Walsh, a founder of the Ordnance Association in 1919; first founder and first editor of ORDNANCE magazine; and at the time of his death, June 11, 1952, president of the Association. He was friend, counselor, and inspiration to many of us assembled here tonight.

"In memory of Jim Walsh the Association has established this annual prize to be awarded to a member of the Association who has not reached his thirtieth birthday and who submits the best essay on an assigned subject. The prize is $1,000. The essay will be published in ORDNANCE magazine. The subject of the 1953 essay was;

It is sometimes said that modern weapons have become so complex that their use and maintenance can be assured only by engineers and technicians of more than average skills. Discuss the truth of this opinion in the light of manpower limitations and what steps might be taken to assist in the solution of the problem.

"The committee of judges who selected the winner consisted of Col. Henry W. Miller of the faculty of the University of Michigan, Ann Arbor, Mich.; Lieut. Col. William Chase of the faculty of Dartmouth College, Hanover, N. H.; and F. W. Foster Gleason, Washington, D.C.; a contributing editor of ORDNANCE magazine, the bimonthly journal of the Association.

"The judges were unanimous in their selection of the winning essay, the author of which I now present to receive the award. He is Mr. Ralph F. Baxter of the Research and Development Division, Rheem Manufacturing Company, Downey, Calif."

The prize-winning essay will be published in full in the March-April issue of ORDNANCE.

THE committee of the New York Post, which directed most successfully the largest meeting of its kind in the history of the Association, consisted, in addition to Admiral Hussey, of the following members of the Post: Chairman John G. Phillips; Vice-Chairmen Arnold W. Hanger, Stanley C. Hope, and Russell L. Maxwell; and the following members:

George W. Allison, J. L. Auer, Admiral Blandy, Thomas F. Brown, Major Comeaux, Roy T. Cowdrey, Paul T. Cullen, Colonel Delafield, Will Eisner, C. L. Farrand, Crosby Field, Mr. Gillmor, John W. Graham, J. M. Gruitch, John M. Hancock, William R. Janney, Sidney D. Kirkpatrick, Henry T. Luria, Don B. MacMaster, E. F. McCrossin, Chester Mueller, Herman A. Peterson, Henry N. Sachs, Lyman F. Stangel, Lloyd W. Stearns, Frederick Tomkins, A. E. Van Cleve, Gordon B. Welch, and Thomas O. Woolf.

The Production Challenge

The science-industry-ordnance team is solving the vital problem of how to keep the Nation ready for immediate and effective defense at a price America can afford to pay

Harry L. Erlicher

THE word from Washington these days is: "Economy and efficiency is our policy." This means greater productivity per man and at less cost. It means getting more value from every defense dollar.

Our Army budget probably will be cut progressively each year for several years—which means that we must build a stronger defense with less money. We can do this through developed know-how, elimination of overtime, concentrated production, and better planning.

We should also be able to lower material costs by substitutions (steel for brass, punchings for castings, etc.) and by the greater use of vendors' specialized skills, lower cost processes, and by better utilization of facilities—at the same time maintaining the quality of our production.

A REDUCED budget also means that certain readjustments must be made in defense spending. Some of these readjustments involve a reduction of spending in some areas with a consequent reduction in employment. Some involve a consolidation of sources of supply. Others involve cut-backs or stretch-outs in delivery schedules which also mean some reduction in the number of persons employed on a given contract at a given time.

These are matters of proper interest to all producers. However, they are readjustments of so gradual a nature that they should offer no great cause for concern. Defense spending is most likely to remain high for a good many years to come, and such reductions as are being ordered currently are not of a size that could logically be expected to constitute a critical test of our elastic economy.

Mr. Erlicher is special assistant for production, Office of the Secretary of the Army, Washington, D. C. This article is based on an address given by Mr. Erlicher before a recent meeting of the Cincinnati Post, American Ordnance Association.

It is hoped that these cuts will mean, instead, more of everything for everybody in the nature of civilian goods.

Something not generally realized is the tremendous development of industry in the last few years and its consequent greater ability to absorb shocks and adjustments to our economy.

Our production of steel ingots, for example, is now nearly double what it was in 1940. Production in that year was 67 million short tons. At present we are producing at the rate of nearly 116 million short tons annually. Production of aluminum has multiplied 6 times—1.2 million tons now as compared with 0.2 of a million tons in 1940.

Sales of consumer goods, such as electric refrigerators, washing machines, and automobile tires have also shown a comparable increase in volume—refrigerator and washing-machine sales have more than doubled in that period.

Regarding the readjustments in our defense production, I am sure that all of you readily approve the adoption of any practicable measures that will effect a saving.

One of these measures is a consolidation of our sources of supply wherever that has seemed desirable. It has seemed desirable in the case of tanks.

Such a move has not been entirely popular in all quarters. It is admitted that there is some risk involved in reducing the number of suppliers because of the increased vulnerability to any kind of an attack and because of the reduced flexibility of our production base. But we have had to take these risks since it is equally as important that we maintain our economic strength as it is our military strength.

WHILE we are generally regarded as the richest nation in the world, we can ill afford to dissipate our economic strength through squandering in any way—much as our prospective enemies would like to have us do so.

Only God knows if or when or where there will be another war. What people we might be called upon to fight and upon what kind of terrain we can only conjecture, but these are the factors that will determine our actual needs. In Korea, for example, because of the terrain we found ourselves fighting an entirely different type of warfare than experienced in World War II.

In so far as our future needs are concerned, we know only that we must be prepared for any eventuality. We must

keep ourselves in a high state of readiness for any and all kinds of warfare, and, during the interim, the people who say we have too much will likely be the first ones to yell "too little and too late."

The bare facts of the case in the instance of our tank production are that production is reaching such a volume that our estimated needs, for as far into the future as any one can foresee, are rapidly being satisfied. With what we have now, or will have soon, it is calculated that we will have enough to tide us over in the opening phases of another conflict until new production can again get under way.

To continue production at a high volume would simply mean a huge stockpile of tanks.

Storage costs and maintenance costs on tanks while they are in storage are very high, and, too, there is always the possibility of obsolescence when the need for them arises, if that need actually does arise.

As for continuing production in low volume at several different places at once, it is evident that production costs can be considerably reduced by consolidation of the manufacturing operations.

As production of tanks, guns, and ammunition meets requirements and is curtailed, other defense plans come into being, such as radar for locating and tracking hostile bombers.

Certainly the Army will continue with the development of new weapons. And Civil Defense, lagging until now, is likely to receive much greater emphasis in the near future than at any time in the past. Any enlargement of this program would have, of course, some effect on our matériel production.

ONE more thing should be remembered about obsolescence as it pertains to research and development. History has proved that weapons still on the drawing board at the outset of a war rarely reach the battlefield until that war is in its last stages. It is therefore of the utmost importance that we continue our efforts in the research and development field in order that we continue to hold the tremendous advantage of superior weapons in the event of another war.

This continuous effort in the field of research and development, I am happy to say, *is* being maintained.

Now let us take a closer look at our actual procurement and production operations as they are being carried on today and as they are affected by the problems of management and supply with which they are so closely interwoven.

In this I shall confine my observations to Ordnance matériel since that is the field in which you have the greatest interest and since it represents such a sizable proportion of the Army dollar. Production of hard goods for the Army increased from $1.2 billion in fiscal year 1951 to nearly $8 billion in fiscal year 1953. Approximately eighty per cent of these amounts represents Ordnance matériel.

ARMY Ordnance has been making tremendous strides in the achievement of greater efficiency in recent months through the adoption of new management techniques and through revised methods of manufacture.

Specific examples of savings in Ordnance are those achieved in improvement of methods of production of 90-, 105-, and 120-mm. rings and gun tubes by which costs of these items have been reduced very substantially.

By the mechanization of assembly and packaging operations on cartridge and shell lines, significant cuts in man-hours per unit have been made possible.

Improvements in manufacturing processes at one plant have saved more than a million production man-hours, representing an estimated savings of more than $1.5 million a year.

Comparison of production costs after an engineering study of the 81-mm. shell line at Ogden Arsenal in Utah showed that the changes which this study effected resulted in an increased production output and a decrease in man-hours per round that will achieve an annual saving of more than $400,000—and this continues year after year.

A continuing effort is being made to insure maximum industry-wide interchangeability of nondurable tools used in the manufacture of small-arms ammunition. Industry-wide controls have been instrumental in limiting excessive purchases, encouraging the use of interplant transfers, and aiding proper identification and classification of tools. The average rate of transfer of tools has amounted to more than $750,000 annually.

THESE are but a few typical examples of the many accomplishments that are taking place throughout the Army organization, and cumulatively they amount to savings of many millions of dollars a year.

Such achievements have been made possible through studies and surveys instigated by Army Ordnance in the fields of time study, work measurement, manpower utilization, and management and manufacturing methods and procedures. The new methods and procedures adopted as a result of these studies and surveys are making a vast improvement in Ordnance efficiency.

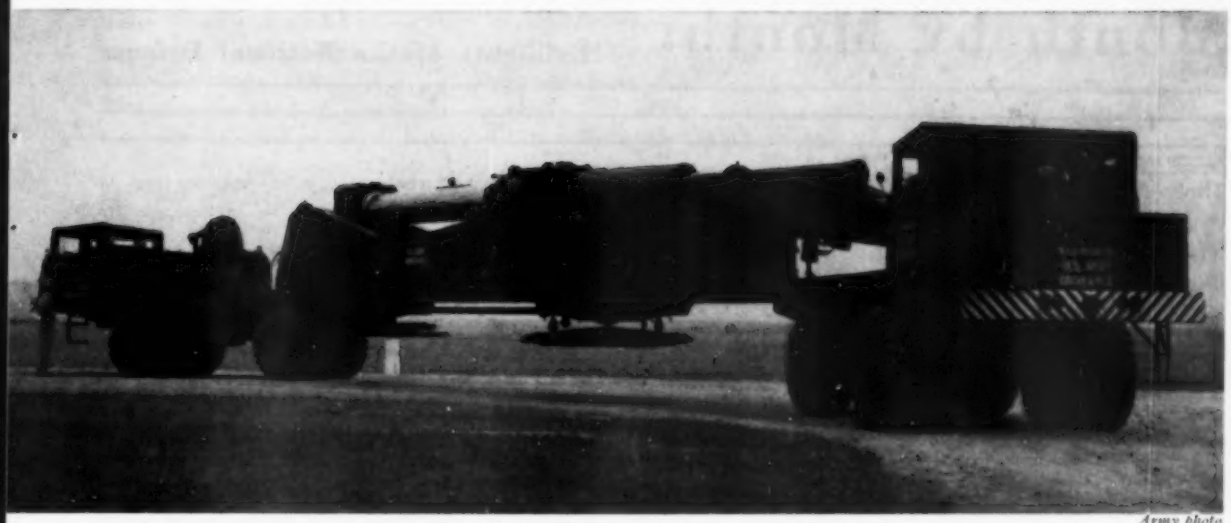
Much credit for these achievements is due the Management Engineering Training School set up by Ordnance at Rock Island Arsenal in April 1952.

To date more than 1,800 Ordnance personnel from 92 of the 97 Ordnance installations in the country have taken some course at this Management Engineering Training School.

An entirely separate area of endeavor on which Ordnance is placing great emphasis is the streamlining of the system of supply.

This activity, dealing primarily with the mechanics of efficient and timely delivery of Ordnance items to the using troops and services, extends also to the scheduling of procurement and production and is having a considerable effect upon these operations.

The primary motive of this endeavor is to render improved service to the troops at less cost and relieve field units of any "excess baggage" that seriously impedes their mobility and, therefore, their effectiveness. By more intelligent regulation of the flow of supplies from the manufacturer to the user, it is considered that millions of dollars can be



Army photo

The many problems involved in making the huge 280-mm. atomic gun were solved by the science-industry-ordnance team.

saved by elimination of overstocking.

Overstocking means added expense for storage facilities, multiple handling and a consequent increase in personnel, a tremendously greater administrative burden, extra hauling and transportation, and a greater risk of obsolescence.

Specific examples of Ordnance efforts toward a streamlined and simplified supply system are:

1. Project 170, whereby a new stock system was ordered into effect in Korea in the summer of 1951. After several years of logistical studies under this project it was determined that ninety per cent of all Ordnance items could be kept operative by keeping on hand only about twenty per cent of the total number of spare parts eventually required to support these items.

BY appropriate streamlining, some division Ordnance units up at the front, which had been stocking as many as 20,000 line items, were able to reduce their stockage to 5,000 items and still furnish improved support with increased self-mobility.

Line items with a low mortality rate continued to be available at base or rebuild shops which furnished direct support when needed, or they were available to the division units through cannibalization of battle losses and wrecks.

By thus drastically reducing the number of items in stock and cleaning many inactive items from the shelves, the mobility of field units is greatly increased and availability at the time of need is markedly improved with resultant savings in storage facilities and procurement funds.

"While we are generally regarded as the richest nation in the world, we can ill afford to dissipate our economic strength through squandering in any way —much as our prospective enemies would like to have us do so. . . .

"In so far as our future needs are concerned, we know only that we must be prepared for any eventuality."

2. A second example of Ordnance supply simplification effort concerns an extension of this program involving improved packaging practices and screening to improve repair-part selection and remove unneeded parts from the Ordnance supply system.

To date over 6,000 separate parts have been reviewed, and more than 1,071 items have been removed from the system as not needed. On the assumption that this ratio will hold true throughout the remainder of the study, millions of dollars' worth of parts will be eliminated and the tonnage now carried in depots and maintenance companies will be greatly reduced.

This change in the techniques of supply has given rise in some instances to the greater use of open-end and call-type contracts in purchasing.

An open-end type contract is for no specific quantity but covers any requirements for a specific period of time. A call-type contract is for a specific quantity of a given item to be called forward as needed.

The advantages of contracts of this type are that they permit better regulation of the flow through the supply pipe line and avoid the necessity for extra storage facilities and additional handling.

An example of an open-end contract is one with an automotive-parts distributor for several thousand separate spare parts to be shipped only in such quantities as are needed when the need arises.

An example of a call contract is one for 1,315,000 gallons of antifreeze for delivery by call during the period June through November 1953. That the effective date of this contract was set for June does not mean that there was any intent to store some quantities in State side Ordnance warehouses. This date was set to accommodate overseas theaters.

Getting more value for our dollar and with fewer dollars to spend during the coming years presents a strong challenge to all of us. However, with industry, labor, and the military working together as a team, I am confident that this challenge can be met successfully.

Month by Month: Highlights of the National Defense

Three Notable Addresses

Three addresses of great national and international significance were recently delivered by three top-ranking officers of our armed forces before American Ordnance Association members in three major cities of our country.

Adm. Arthur W. Radford, Chairman of the Joint Chiefs of Staff, speaking at the Annual Industrial Preparedness Dinner Meeting of the Association in New York City on December 2, 1953, warned the American people that peace depends most upon a small group of men in the Kremlin.

> *"This is one of the hard facts of international existence which we must accept," he said. "It is within the power of this small Soviet group to decide upon a shooting war, to make such a decision secretly, and to make the initial attack with little or no warning. We cannot close our eyes to this fact.*

"Actually, we are faced, even now, with *their* idea of war. The fact that it does not involve the massed onslaught of military forces, does not detract from the fact: This is war today. Wars can be, and are, fought in other ways as well."

Gen. Matthew B. Ridgway, Chief of Staff, United States Army, addressed the Cleveland Post of the Association on November 10th.

"The Communist forces in Korea did not yield to threats," he said, "though the mastery of the seas around them and domination of the sky above them by United Nations forces were all but complete. Logistical supply continued, even increased in effectiveness. At armistice time our enemy there had greatly increased the offensive capability with which he began.

"We learn lessons from these historical facts. They prove what all of military history to date has proved, and with ever-increasing clarity in modern times, that there is no magic in the successful conduct of campaigns—that sound planning and timely preparation of properly balanced military strength offer the only way by which we may expect successfully to defend ourselves."

Gen. B. W. Chidlaw, Commanding General of the U. S. Air Defense Command, recently expressed the view, before members of the Cincinnati Post of the Association, that "since, in this atomic age, our only real security lies in *preventing* war, the man in the street must realize that if we are to avoid the horrors of a war fought with weapons of mass destruction this Nation *must* attain and maintain a military posture of both offensive and defensive potential which will deter our enemies from ever launching the initial atomic strike.

> *"The maintenance of such military posture is expensive, will continue so, and will entail sacrifices by our people over a period of time, the length of which no one today is competent to foretell."*

All three addresses are published in this issue of ORDNANCE—truly an historic issue. They are a timely tribute to the important rôle of the American Ordnance Association in national defense..For this recognition we are most grateful.

General Ford Retires

The retirement of Maj. Gen. Elbert L. Ford, Chief of Army Ordnance, marks another dramatic milestone of outstanding achievement in the never-ending struggle to provide superior combat equipment for the best foot soldier in the world—the American GI.

> *Conventional weapons have been developed to a new peak of effectiveness. Ordnance has also, under General Ford's highly competent leadership, made available to our troops a whole new atomic arsenal.*

These weapons will still further reduce American battlefield casualties and exact the most severe penalties from an enemy that may be numerically superior.

Reviewing his four years in office, General Ford listed the following as significant developments in the conventional field:

Trucks.—The power, durability, and capacity of the "six-by-six" have been improved greatly since World War II days. The rugged terrain of Korea was both a challenge and a proving ground for the standard field transport vehicle of the Army. It is rated the finest vehicle of its kind in the world.

Tanks.—A whole new series of light and medium tanks have been brought from the drawing board to the combat line during the last four years. Some of these had minor defects when first released to the troops. This was a calculated risk, and one which paid off. These defects, of course, have now been corrected.

Antiaircraft Artillery.—The celebrated 75-mm. "Skysweeper" is reported to shoot higher, faster, and with greater accuracy than any other gun of its caliber in the world. Its accuracy comes from improved electronic devices, the development of which has created virtually an entire new military industry since 1949.

Guided Missiles.—Much information about guided missiles has been kept secret. However, Army Ordnance development of such ground-to-air guided missiles as "Nike" is known to have passed from the experimental to the production phase. Major American cities will shortly be ringed by guided-missile emplacements.

> *In addition to these advances there have also been important developments in ground artillery and small arms.*

No artillery weapon in the world today can compare in general-purpose utility to the 105- and 155-mm. howitzers, the standard artillery of infantry divisions.

Recoilless rifles proved their value in Korea. In addition to the 57- and 75-mm. weapons, Army Ordnance has developed a 105-mm. rifle.

Ammunition has been improved to a considerable extent. Although Korea was not much of a tank war, tests indicate that our troops in the field now have the punching power to penetrate any armored vehicle a future enemy is likely to produce.

Development of infantry weapons has been directed toward making the American foot soldier superior, not to just one enemy soldier, but to a large number of the enemy. The M1 (Garand) rifle is still the best infantry arm in the world.

The new 3.5-inch bazooka far outclasses the old 2.36-inch rocket, and is now standard for our infantry.

Plant Dispersal

During the past year a number of patriotic citizens have attempted, without much success, to drive home to the American people the enormous destructive power of the A-bomb and the H-bomb.

In a speech delivered at Marquette University, Milwaukee, Wis., on December 5th, Thomas E. Murray, Commissioner of the U. S. Atomic Energy Commission, asserted that all our leaders who one day may have some responsibility, be it ever so small, for a decision for war, should know atomic facts at firsthand.

Hanson W. Baldwin, *The New York Times* military analyst, has pointed out that since important communication junctions are usually in or around cities, and since cities are also clustered around important war-supporting industries and many power sources, strategic and tactical targets in an atomic war overlap and blur. This is particularly true in the case of ports, which support land armies, fleets, industries, and submarine bases.

"Moreover," Mr. Baldwin wrote, "the development of the thermonuclear or so-called hydrogen weapon, with its potential destructive capacity measured in megatons (millions of tons) and its area of destruction of 100 to 300 square miles (as compared with the 2 to 10 square miles of the Hiroshima bomb), further confuses the picture. For the hydrogen bomb has, contrary to the lay impression, potential tactical utility of great importance."

Despite this and other evidence of similar serious import, very little progress has been made in persuading manufacturers to take the industrial-dispersal program seriously. There is very little interest on the part of other segments of our population. Thus schools and hospitals are still being put up as if the A-bomb and the H-bomb did not exist.

> *According to a recent estimate, about seventy-one per cent of the country's productive capacity is still concentrated in fifty metropolitan centers. A few enemy bombs, if successfully delivered, could cripple the Nation—perhaps irreparably—in one day.*

The Government has offered certain inducements to private industry to make itself as bombproof as possible. Sturdier plant construction will cost about twenty per cent more than conventional construction, but the Government is offering accelerated amortization and a 5-year tax write-off.

One company is building atom-bomb shelters for its employees. Few American companies are even planning underground factories. Plant dispersal is receiving only very tepid consideration.

All that the Nation's defense planners at the moment can do is to mutter plaintively, "You'll be sorry!"

The New 280-mm. Gun

"Firepower to offset manpower continues to be our goal."

Army Secretary Robert T. Stevens told the National Guard leaders that superior firepower continues to be the major aim of the Army's research and development program.

"The Army's research and development program has been the spearhead of our progress," he declared, "and is being carried forward with full vigor in all fields.

> *"We want our troops to have in the future, as they do today, the kind of weapons and equipment which, combined with thorough training, excellent leadership, and high morale, can be counted upon to offset any potential enemy's quantitative superiority in manpower."*

The most dramatic advance in our program to build the firepower of our units has been the development of atomic weapons for battlefield use. Mr. Stevens called particular attention to the firing of the first atomic shell from our new 280-mm. gun. This gun can hurl either atomic or conventional projectiles further and with greater accuracy than any other artillery piece in our arsenal.

"The new giant," Mr. Stevens said, "has tremendous mobility. It can move along a highway at thirty-five miles an hour and across country with ease. It can be emplaced in a matter of minutes and fired around the compass. It is so delicately balanced that one man can elevate or depress it by hand if the power mechanism should fail.

"This gun," he concluded, "will greatly enhance our defensive capabilities, which is why we have shipped some of them to Europe.

> *"Ultimately, as Army guided missiles are perfected, they too will aid in delivering fissionable materials or conventional explosives in close support of Army ground forces.*

"The important thing is that we have the gun *now* and can give our field commanders the capability of using atomic explosives safely and accurately in darkness or in any kind of weather, if it should become necessary to do so."

Resources Conferences

The National Resources Conferences, sponsored by the Industrial College of the Armed Forces, seek to foster a better understanding of the many interrelated problems associated with national security, a stronger appreciation of the inseparable nature of the civilian-military team, and a clear recognition of the limitations and capabilities of each half of the team.

They seek to encourage application of the highest level of skill, intelligence, and imagination to the complex prob-

lems which must be solved if the heritage of freedom is to be secure.

> *As in past years, a National Resources Conference, formerly known as a Field Economic Mobilization Course, will be given on a 2-week basis (four hours each day and five days a week) in cities across the country.*

A conference consists of a presentation of the broad principles of economic mobilization from an educational point of view. It is organized to present the problems which will confront the country in a mobilization of the national economy for war; the resources and economies of potential belligerents, allies, and neutrals; the methods and procedures for making the best use of the national resources.

The conferences are open to Reserve officers and civilians. The 1954 schedule is as follows:

San Jose, Calif., January 18-29; New Orleans, La., February 1-12; Dallas, Tex., February 8-19; Wilmington, Del., March 1-12; Atlanta, Ga., March 8-19; Pasadena, Calif., April 5-16; Pittsburgh, Pa., April 5-16; Omaha, Nebr., April 26-May 7; Minneapolis, Minn., May 3-14.

The military quota for each conference is 170. Quotas for civilians are limited only by eligibility criteria and by the use of the auditorium in which a conference is held.

The Alden Award

The Colonel Alden Scholarship Prize Essay Contest is open to all military students, either officers or enlisted men, who are or will be enrolled in scheduled Ordnance School courses during the period July 1, 1953, through April 1, 1954.

> *The prize will be $100 in cash, and the award will be announced in the July-August 1954 issue of this magazine and will be transmitted to the winner by the American Ordnance Association.*

The Association has authorized the commandant of the Ordnance School, Aberdeen Proving Ground, Md., to administer the contest.

The contest is held annually in memory of Col. H. W. Alden, Ordnance Corps, U. S. Army.

Colonel Alden, a native of Vermont, was one of the founders of the American Ordnance Association, as well as a founder of the Society of Automotive Engineers. He served with distinction in World War I as an Ordnance officer.

Colonel Alden was chief engineer and, subsequently, president of the Timken-Detroit Axle Company. He was known throughout the automotive industry and the Ordnance Corps as the "dean of axle engineering."

The company, as a memorial to Colonel Alden, has made available a principal sum of $5,000, the income from which is used to provide the annual award.

The rules of the contest are as follows:

1. The 1953-1954 contest is open to all military students, officer or enlisted man, who are or will be enrolled in scheduled Ordnance School courses during the period July 1, 1953, through April 1, 1954. Members of the staff and faculty of the Ordnance School are not eligible to participate.

2. The topic for the 1953-1954 contest will be: "My proposal for the single most effective action that could be taken to improve ordnance service to our combat forces, together with the reasons supporting my proposal, is as follows. . . ."

3. Essays must be submitted on or before March 1, 1954.

4. Essays must not exceed 3,000 words.

5. Essays must be presented on 8 by 10½ inch paper on one side of the paper only. It is essential that all essays be neat and legible.

6. The name and address of the contestant will be written on the title page only, and will not appear on any other page of the essay.

7. All material submitted will become the property of the American Ordnance Association.

8. Essays will be submitted to the Secretary, the Ordnance School, Building 3071, Aberdeen Proving Ground, Md.

The prize-winning essay will be selected by a committee to be appointed by the commandant of the Ordnance School. Originality and independence of thought as well as the value of the suggestion to the Ordnance Corps will be the main criteria employed in evaluating the essays submitted.

Navy Experts Decorated

Three scientists have been awarded the Navy's highest civilian award for their work with guided missiles.

In ceremonies last November at the Allegany Ballistics Laboratory, which the Hercules Powder Company operates for the Navy at Cumberland, Md., Assistant Secretary of the Navy Raymond H. Fogler presented the Distinguished Public Service Award to Ralph F. Preckel, Lyman G. Bonner, and Richard Winer.

Attending the ceremonies were the late Rear Adm. W. S. Parsons, Deputy Chief of the Navy Bureau of Ordnance, officials of the company, and other distinguished guests.

The award cited the scientists for "developing new propellants which make possible the use of guided missiles and rockets over a much wider range, greatly enhancing the performance and safety of those weapons."

Aberdeen Uses Television

The high-explosives loading, assembly and disassembly plant at Aberdeen has adopted the use of industrial television to insure maximum safety for employees working with potentially dangerous material.

The plant, known as Magazine No. 700, was originally planned during War II. However, the end of hostilities canceled appropriation of funds, and the idea was abandoned. With the outbreak of fighting in Korea the blueprints were taken out of file, and the plan became a reality.

Television was first adopted in the plant in November and is now employed as a safety device, in four of the plant's seven workrooms or bays.

After setting up a machine for a drilling or cutting process, one of the four television cameras is placed in position. From behind the safety wall the operator controls the machine by watching his TV monitor. The television is also an additional guard against the ever-present danger of fire.

Keep Morale High

An Editorial

GEN. Matthew B. Ridgway, Chief of Staff of the Army, stresses over and over again and with wise precision the crying need for morale among our fighting forces. His philosophy is based upon the sound premise that the morale of our fighting men is no stronger than the morale of all our people.

His is a wise course in bringing home to all of us the need for understanding, coöperation, and hard work in developing the team play which is so essential to every worthwhile organization, be it school, church, regiment, manufacturing company or laboratory.

In recent weeks the American Ordnance Association received from General Ridgway the following very significant letter:

"I recently wrote to the association of the U. S. Army, of which I have long been a member, to express my view of the importance of the association's work and to encourage its continued support by all of us in the Army.

"I also want to express my great interest in your association and every association which is dedicated to advancement in the fields of the various arms and services of the Army. I know of no more significant bond between men and women who have the progress of our armed services at heart than to be fellow members and supporters of these outstanding organizations.

"To join an association of this nature and participate actively in its functions means to promote coöperation and good will, to exchange and disseminate valuable professional information, to develop *esprit* and mutual respect—in effect measurably to strengthen the national capability for defense.

"In particular, I want to emphasize the rôle of the association journals. These journals not only make a significant contribution to current thinking in the arms and services but provide a unique opportunity for the professional development of the contributing members.

"I strongly urge the support of these fine military associations and their outstanding publications."

THE American Ordnance Association takes this public means of thanking General Ridgway and adds its hearty approval and sympathetic support to his appraisal of the other Army associations. The so-called military associations to which the General refers are performing an outstanding service in the upbuilding of the morale in their respective fields.

The Quartermaster functions of the Army are being the better performed and *esprit* is the higher by reason of the long and fruitful service of the Quartermaster Association. The military engineering functions of the defense services are all the better because of the glorious contribution of the Society of Military Engineers.

As the General cites, the Association of the United States Army, formerly the Infantry Association, is a leader in the field of thought and action toward making the American soldier a better fighting man and a more capable citizen. The Association of Military Surgeons, in its vastly important field, is supporting, as it has for many years, the functions of military medicine and surgery which redound to the safety of life and limb of our fighting forces.

THE Armor Association carries on brilliantly the historic function of its predecessor, the Cavalry Association. Likewise, the Antiaircraft Association carries forward the long tradition and inspiration of the former Coast Artillery Association, while the Armed Forces Communication Association and the Armed Forces Chemical Association in their respective areas of operation are lending the support and inspiration upon which much of the high morale of military personnel engaged in their important enterprises depends.

All these splendid organizations, as is the case with the American Ordnance Association, publish technical journals similar to ORDNANCE which are the vehicles for stimulating thought and advancing an adequate understanding of the particular segments of the military establishment.

Then there are the newer organizations which do not have as yet the time-tried records of their older brethern. These include the Military Chaplains Association, the Air Force Association, the Finance Association, the Military Police Association, the National Security Industrial Association, and others.

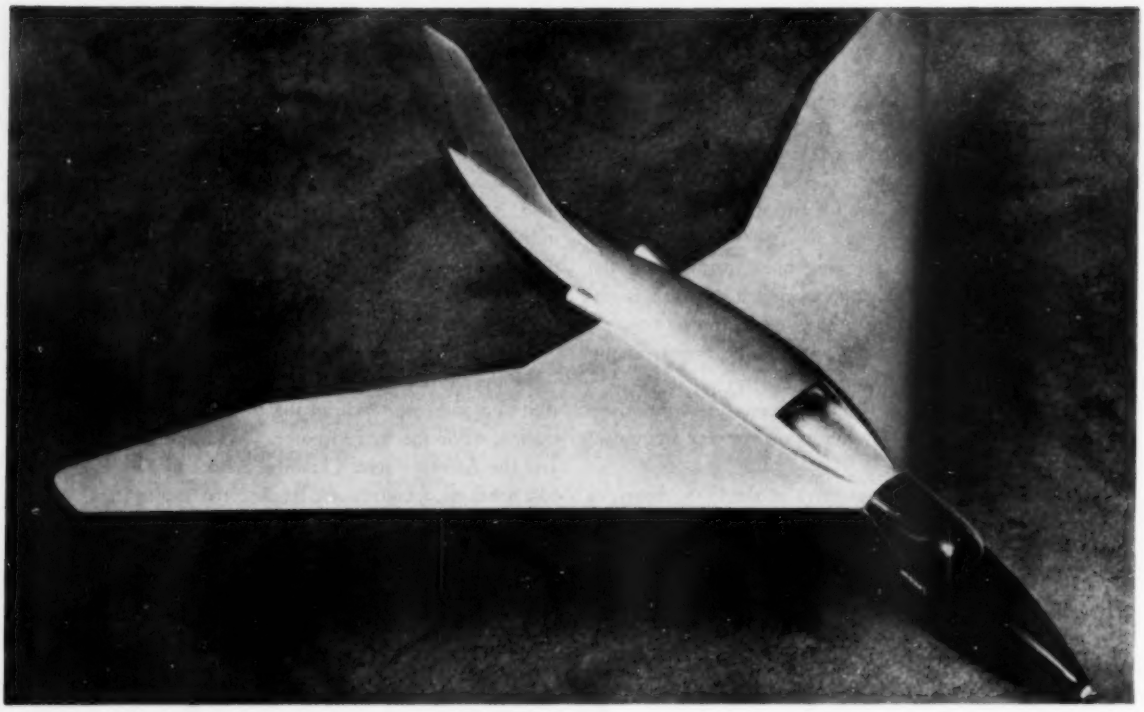
Frequently, some skeptics express the query: Why all these separate organizations and why not one organization to perform all these functions?

The answer is in the simple yet homely fact that bigness is not necessarily a symbol of efficiency, and oneness is by no means a guarantee of high morale. There is a very definite place and, indeed, a pressing need for morale builders among all the major parts of the military establishment of the United States.

The A.O.A. is the catalyst between American science and industry on the one hand and the fighting forces on the other. It is the guarantee of superior fighting equipment in adequate quantities when and where needed. The morale factor is as vital as the technology, engineering skill, and production lines which are a part of its field of operations.

That high morale throughout all the elements of the armed forces be maintained independently and that there be great individual pride in ordnance—land, sea, and air—has been the philosophy of the A.O.A. from its beginning. We commend the Chief of Staff for his timely letter, and along with our sister organizations we hope always to fill our assigned rôle creditably and promptly and in coöperation with "every association which is dedicated to advancement in the fields of the various arms and services of the Army."

New British Matériel



Shown above is a model of the British Short Serpa experimental aircraft. With rotating wingtip controls it is expected to have great influence on the wing shape of future high-altitude airplanes. The new British tank, the Caernarvon, below, has a more powerful engine and better armor than the Centurion tank which won high praise in Korea (British photos).

Reg. U. S. Pat. Off.

INDUSTRIAL PREPAREDNESS

a monthly report on current scientific and logistical developments as they relate to the national defense

AMERICAN ORDNANCE ASSOCIATION • *Founded in 1919* • 705 MILLS BUILDING, WASHINGTON, D. C.

No. 87 January 1954

● **The fourth meeting** of the Metal Lubricants Committee of the American Ordnance Association was held at the Wright Air Development Center, Wright-Patterson Air Force Base, Ohio, on Wednesday, October 28, 1953.

The technical session of this meeting was opened at 9:15 a.m., with an attendance of thirty-two, by Committee Chairman Wilbur J. Reitze of the Esso Standard Oil Company, New York City.

Representing Maj. Gen. Albert Boyd, commander of the Wright Air Development Center, who was unavoidably absent on detached service, Col. William L. McCulla welcomed the Committee to Wright Field and described the organization and mission of the Development Center as an important segment of the Research and Development Command of the Air Force. A number of the key executives and engineers of the Air Development Center also attended this meeting.

The following agenda gives a good outline of the technical military lubrication problems discussed:

1. Status of cutting-oil performance tests as a basis for military specifications. This discussion included a summarized report of tests being conducted by the A.S.T.M. and resulted in the appointment of a subcommittee to prepare an interim report for the military on this problem.
2. Grinding oil tests.
3. Report on tool life in rifle broaching.
4. Report on lead compounds in soluble oils.
5. Report on T.C.P. and chlorine in soluble oils.
6. Forming and wire-drawing of titanium.
7. Core oils. This discussion included a review of tentative core-oil specifications which were generally considered satisfactory with a few modifications. Definite Committee recommendation on this proposed specification is now awaiting completion of some particular testing being conducted at the Naval Gun Factory, Washington, D.C.
8. Discussion of low-jet application of coolants.
9. Progress on machining and grinding of titanium.
10. Machining and grinding of stellite.
11. Drilling and tapping of vanasil and sintered powdered tungsten.
12. Lubricants for heavy forging and extrusion.
13. Progress report of effect of stain of sulphur cutting oils on rejection of ordnance parts.

The technical portion of the meeting ended at 12:15 p.m. with an oral summary by the chairman of the conclusions reached during the course of the morning's meeting.

Following luncheon there was a guided tour arranged for the Committee to the shop areas, the Communication and Navigation Laboratory, the Aëronautical Research Laboratory, and the Equipment Laboratory.

The next day the Committee members journeyed to Cincinnati, Ohio, and attended the afternoon technical seminar and evening dinner session of the annual meeting of the Cincinnati Post of the American Ordnance Association.

● **Three scientists in the field of guided missiles** were presented recently with the Navy's highest civilian citation, the Distinguished Public Service Award, in ceremonies at the Allegany Ballistics Laboratory which the Hercules Powder Company

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operates for the Navy Department at Cumberland, Md.

Ralph F. Preckel, Lyman G. Bonner, and Richard Winer received the award from Assistant Secretary of the Navy Raymond H. Fogler who was also the principal speaker for the occasion.

The scientists were cited for their work in developing new propellants which make possible the use of guided missiles and rockets over a much wider range, greatly enhancing the performance and safety of these weapons.

Rear Adm. W. S. Parsons, late Deputy Chief of the Navy Bureau of Ordnance, officials of Hercules Powder Company, and other distinguished guests were present at the ceremony.

● **The regular annual meeting** of the Rocket and Jato Committee, American Ordnance Association, was held at the Redstone Arsenal, Huntsville, Ala., on November 4, 5, and 6, 1953. This very important meeting was conducted by the chairman of the Rocket and Jato Committee, C. L. Eksergian, executive engineer of the Budd Company, Philadelphia, Pa.

In attendance were 85 representatives from American industry and 25 military representatives from the Army, Navy, and Air Force. In addition, approximately 60 key executives and engineers of the Redstone Arsenal attended the technical session.

At this session, which lasted from 8:30 a.m. until 5:00 p.m. on November 5th, carefully prepared classified technical papers dealing with current rocket problems of development and manufacture, including recommendations thereon, were presented by the following:

Brig. Gen. H. N. Toftoy, director, Ordnance Missile Laboratory, Redstone Arsenal; Dr. C. M. Hudson, Rocket and Launcher Section, Army Ordnance, Washington, D. C.; Joseph Pinsky, assistant manager, Propulsion and Structural Research, Armour Research Foundation; John M. Schwartz, chief, Rocket Section, Army Ordnance, Washington, D.C.; A. W. Zimmer, vice-president, Reo Motors, Inc.; Larry Shiller, chief, research and development engineering, Norris-Thermador Corporation; Ray Wilcox, superintendent of manufacturing, Motor Wheel Corporation, Lansing, Mich.;

Also, Joseph Farley, government contract manager, Dexter Company, Fairfield, Iowa; H. G. Jones, chief, Rocket and Launcher Section, Research and Development Division, Army Ordnance, Washington, D.C.; Dr. John Hyndman, research engineer, Rohm & Haas Company, Redstone Arsenal; Howard L. Miller, metallurgical engineer, Republic Steel Corporation, Cleveland, Ohio; F. S. DeWitt, vice-president, Parker Rust Proof Company, Detroit, Mich.; Melvin Johnson, Ordnance Ammunition Center, Joliet, Ill.; Weber deVore, manager, Ordnance Division, Heintz Manufacturing Company, Philadelphia, Pa.;

Also, Ben Kaul, director, technical development and research, Mullins Manufacturing Company, Salem, Ohio; Lieut. Col. E. N. Hall, assistant chief, Power Propulsion Laboratory, Wright-Patterson Air Force Base, Dayton, Ohio; Robert J. Mill, chief, Rocket Department, Aerojet General Corporation, Azusa, Calif.; A. F. Giacco, technical director, Radford Arsenal, Va.; L. D. Warner, vice-president, American District Steam Company, North Tonawanda, N.Y.; Carl E. Johnson, chief engineer, Scaife Company, Pittsburgh, Pa.; H. E. Kirkpatrick, executive vice-president, Delta Tank Manufacturing Company, Baton Rouge, La.; M. F. Kroesch, chief engineer, Pressed Steel Tank Company, Milwaukee, Wis.

At the evening session on November 5th, Mr. Eksergian presided and introduced Leo A. Codd, executive vice-president of the American Ordnance Association, who acted as master of ceremonies and introduced the principal speakers.

Seated at the speakers' table during this session were: John M. Schwartz, chief, Rocket Branch, Office of the Chief of Ordnance, Washington, D.C.; Mr. deVore; General Toftoy; James D. Maitland, president, Rocky Mountain Post, Denver, Colo.; Capt. R. L. Adams, Assistant Chief, Bureau of Ordnance, United States Navy, Washington, D.C.; Brig. Gen. T. K. Vincent, commanding general, Redstone Arsenal, Huntsville, Ala.; Mr. Eksergian, chairman, A.O.A. Rocket Committee, and executive engineer, the Budd Company, Philadelphia, Pa.

Also at the speakers' table were: Maj. Gen. L. E. Simon, Assistant Chief of Ordnance for Research and Development, Washington, D.C.; Col. E. N. Hall, assistant chief, Power Propulsion Laboratory, Wright-Patterson Air Force Base, Dayton, Ohio; Walter N. Howley, chairman, A.O.A. Shell Committee, and president of Lansdowne Steel & Iron Company, Morton, Pa.; Brig. Gen. J. B. Medaris, chief, Industrial Division, Army Ordnance, Washington, D. C.; Col. Henry N. Marsh, general chairman, A.O.A. Technical Divisions & Committees, Hercules Powder Company, Wilmington, Del.; H. G. Jones, chief, Rocket and Launcher Section, Army Ordnance Research and Development Division, Office, Chief of Ordnance, Washington, D.C.; and Brig. Gen. Burton O. Lewis, A.O.A. staff consultant for Technical Divisions and Committees.

The principal speakers at the evening session were:

General Vincent, who spoke on the purpose and accomplishments of Redstone Arsenal in proving rocket developments;

General Medaris, who discussed expediting manufacture of new rocket and ammunition developments;

Captain Adams, whose topic was producibility of rocket design;

General Simon, who spoke on the development and rôle of the modern rocket.

On Friday, November 6th, the members of the Rocket and Jato Committee and their guests were privileged to visit the laboratory and testing facilities of Redstone Arsenal and to witness a variety of rocket firings.

● **The Defense Department** recently set December 31, 1953, as the deadline for the individual military services to submit proposals to buy $250 million worth of machine tools, equipment, and storage space needed to boost the Nation's industrial-mobilization capacity.

In this directive to the military services, Assistant Defense Secretary Charles Thomas also set standard procedures for buying tools and equipment for the "mobilization base" program.

Although Congress voted $250 million for the program as a part of the military appropriations for the present fiscal year, actual purchases have been delayed until detailed buying policies could be worked out.

The directive provides that all projects proposed by the services must be submitted for the approval of Defense Secretary Charles E. Wilson. Furthermore, because the amount of money available for reserve equipment and facilities is limited, "projects submitted should be most essential and worthy, and the total submissions by any department should be reasonable in the light of the total appropriation."

Mr. Thomas established a number of rules defining the "spirit and intent" of the mobilization base program. They require that the projects be directly related to production of specific types of military equipment which will be critically short in the event of an all-out war and which are not likely to become obsolete within a few years. Furthermore, reserve facilities proposed by the services must require a long lead time for construction and they should be suitably disbursed as a safety measure in case of enemy attack.

The directive provides that proposals for outright purchase of entire production facilities, including tools and equipment, should be limited to "exceptional cases." Such cases might arise whenever the Government would be compelled to dismantle production lines or move Government-owned equipment at great expense from privately owned plants, the directive said.

● **The Department of Defense** has lost its battle to continue the "restricted" classification on security documents.

Defense Department instructions, therefore, are expected soon calling for the reclassification of all documents now so marked. Thousands of military contracts, regulations, letters, messages, etc., now are marked "restricted."

The demise of the familiar classification came with President Eisenhower's Executive Order designed to give the public a freer flow of information about their Government without endangering national security. The order became effective December 15, 1953.

A defense policy to be issued will spell out details for the services. Besides directing only three classification categories—top secret, secret, and confidential—the Executive Order does the following:

1. Takes away document-classifying authority from 28 Federal agencies, such as the Veterans Administration and American Battle Monuments Commission.

2. Gives classifying authority to heads only, with no power to delegate it to some one else, of 17 agencies.

3. Defines what information is to be classified and how it is to be stored, transmitted, marked, and destroyed.

4. Permits the Defense Department to name an employee as classifying officer.

The new order replaces a controversial measure issued by former President Truman in September 1951. Abolition of restrictions will create more problems for the press, public, and Government than the old order, some Pentagon officials feel. More than 90 per cent of all Government classified documents originate in the Defense Department. The number of classified papers is so vast that it may take months to screen them.

It is believed that a great many of the currently restricted documents will have to be upgraded to "confidential."

● **Twenty-one patents** recently have been released for public use by the United States Atomic Energy Commission. Descriptions of these patents owned by the U.S. Government and held by the Atomic

FUTURE SCHEDULED MEETINGS OF NATIONAL TECHNICAL DIVISIONS AND SPECIAL COMMITTEES OF THE AMERICAN ORDNANCE ASSOCIATION

- **Propellants and Explosives Committee of the Advisory Technical and Research Group at the Waldorf-Astoria Hotel, New York City, December 2, 1953.**
- **Dimensional Standards and Metrology Division at Eglin Air Force Base, Fla., January 7-8, 1954.**
- **Instrument Jewel Bearings Committee of the Fire Control Instrument Division at Frankford Arsenal, Pa., January 14, 1954.**

Energy Commission have been transmitted to the U.S. Patent Office for registry and listing in the official register of patents.

The Commission will grant nonexclusive, royalty-free licenses on the listed patents as part of its program to make nonsecret technological information available for use by industry. Commission-held patents and patent applications released for licensing now total 614.

Applicants for licenses should apply to the Chief, Patent Branch, Office of the General Counsel, United States Atomic Energy Commission, Washington 25, D.C., identifying the subject matter by patent number and title. Copies of these patents may be obtained from the United States Patent Office.

● **The Hon. Donald A. Quarles,** Assistant Secretary of Defense for Research and Development, in a recent address at the Institute of Industrial Research, Detroit, Mich., outlined the scope and activity of his office in part as follows:

"I feel that the existing momentum of the three services in research and development must be maintained. Rather than wholesale reorganization from the laboratory level upward, we must provide assistance and guidance to the three departments in their research and development operations. Without in any way denying the ultimate responsibility and authority of the Secretary of Defense, there must be a large degree of decentralization.

"The responsibility of the services for research and development operations is recognized. It is a fundamental and inseparable phase of their over-all responsibility to provide themselves with proper weapons. The three military departments are considered to be individually responsible for planning and executing sound departmental research and development programs.

"The Assistant Secretary of Defense for Research and Development has the responsibility for developing policies and establishing procedures to insure the effective conduct of research and development operations by the military departments. The policies must provide for sound research and development objectives; for plans based on these objectives; and for budgets, facilities, and organizations to implement the plans.

"The Assistant Secretary must see that all these things come to pass, not only by his own actions in policy preparation but also by reviewing service operations and by providing the leadership and guidance for those operations.

"In order to facilitate meeting the service responsibilities for coördination and to assist in the review of the research and development operations for the Secretary of Defense, it is planned to set up 'in-service' coördinating committees for the dozen or so major research and development technical areas. These groups will consist of the principal departmental officials in the particular fields, as well as a senior member of my staff.

"These in-service coördinating committees will provide for the coördination so necessary for the effective and economical performance of our research and development.

"Carrying this concept of in-service steering groups to its logical conclusion, I will depend heavily on a research and development policy council consisting of the chief civilian and military research and development officials of each department for advice and guidance to me personally on the broad aspects and on policy matters.

"To benefit from the experience of civilian scientists in the planning and review of our activity, it is planned to establish technical advisory panels in the various scientific and technical fields. These panels are to consist entirely of persons selected for their professional competence in those fields.

"The civilian advisory panels will review the military research and development programs assigned to each group. They will advise the cognizant in-service coördinating committees with respect to the military programs, and they will report their conclusions and recommendations to the Assistant Secretary for Research and Development, noting particularly their endorsement of disagreement with the technical programs of the departments.

"An unobstructed, unfiltered communications channel would thus be provided for the flow of new ideas and unconventional weaponry proposals to the top echelons of the Department of Defense."

ASSOCIATION AFFAIRS

Cincinnati Post Awards the Harrison Medal to Gen. Benjamin W. Chidlaw

The annual meeting of the Cincinnati Post was held at the Netherland-Plaza Hotel on October 29, 1953. The Charles L. Harrison Gold Medal for Distinguished Ordnance Service was awarded the guest of honor, Gen. Benjamin W. Chidlaw, Commanding General of the Air Defense Command, Colorado Springs, Colo. General Chidlaw is a native of Cincinnati.

The dinner meeting was preceded in the afternoon by an outstanding technical session presided over by Harry S. Robinson, chief of the Cincinnati Ordnance District, at which Professor O. W. Boston of the University of Michigan gave an illustrated lecture explaining some of the difficulties encountered in the machining of titanium.

Harry L. Erlicher, Special Assistant in the Office of the Assistant Secretary of the Army, discussed procurement policies and problems and summarized the procurement outlook for the future.

John E. Storer, chief engineer, transmission operations, Allison Division of General Motors Corporation, described the step-by-step improvement in tank transmissions developed by Allison and the nature of present research and development to improve performance and save weight. Slides and diagrams were used to illustrate a very informative talk.

Post President Harold R. LeBlond presided at the dinner meeting and was toastmaster. The invocation was given by the Rev. Luther Tucker. After a stirring message on behalf of the Association from Leo A. Codd, executive vice-president of the Association, the citation accompanying the Harrison Award was read by Frederick V. Geier, a Post director, and the award was presented to General Chidlaw by Harvey C. Knowles, national A. O. A. vice-president who is also a Post director.

There followed a talk on the air defense of the United States by General Chidlaw in which the problems were presented with great clarity and the solutions indicated in an able manner. The complete address of General Chidlaw is published on page 585 of this issue of ORDNANCE.

Those at the head table in addition to those mentioned above included J. M. P. Wright, R. G. Calton, E. A. Muller, O. P. Winningstad, G. L. Holsinger, William H. Mitchell, C. W. LaPierre, P. E. Rentschler, R. E. LeBlond, C. L. Harrison, C. W. Irvine, P. N. Strong, F. H. Herrald, E. W. Harrison, C. A. Cozart, W. W. Tangeman, J. D. O'Brien, L. W. Scott Alter, C. P. Schneider, D. A. Meeker, J. B. Doan, and Burton O. Lewis.

Colonel Slezak Receives the Campbell Medal and Addresses Regional Meeting

Col. John Slezak, Assistant Secretary of the Army for Matériel, was awarded the Levin H. Campbell Gold Medal for Distinguished Ordnance Service at a regional meeting of the Association held at the Palmer House, Chicago, November 12, 1953.

Colonel Slezak has been appointed by President Eisenhower to become Under Secretary of the Army on January 25, 1954, succeeding Earl D. Johnson.

The capacity of the hotel ballroom was taxed by the large number of members of the Association and friends of Colonel Slezak who were in attendance. The medal was presented by General Campbell whose name it bears and who read the following citation:

"The American Ordnance Association, in appreciation of outstanding service to the national defense of the United States, awards its General Levin H. Campbell Gold Medal to Col. John Slezak, Officers' Reserve Corps, United States Army, Assistant Secretary of the Army, a director of the Association, and president on leave of its Chicago Post.

"In two World Wars, during the Korean War, and throughout the years between these conflicts, from 1918 until the present time, Colonel Slezak has displayed deep loyalty to the United States of America by his tireless energy in contributing to the advancement of Ordnance preparedness.

"A leader in industry, he has made available to the armed forces of this country his best talents at all times. As a private in the United States Army in the First World War, as a colonel in charge of the Chicago Ordnance District in the Second World War, and presently as Assistant Secretary of the Army, Colonel Slezak was and is an exemplar of patriotic zeal, industrial leadership, and personal integrity of such high degree that the members of the American Ordnance Association honor themselves by thus honoring him."

The speaker of the evening was Colonel Slezak. His address appears on p. 588.

General Campbell acted as toastmaster, and the presiding officer was Lieut. Col. William G. Swartchild, Jr., vice-president of the Chicago Post. The following were seated at the speakers' table:

EDWARD J. O'KEEFE, secretary, Chicago Post, A. O. A., and partner, O'Keefe & Walters, *Chicago, Ill.;*

LIEUT. COL. L. V. GERMAIN, commanding officer, Signal Corps Supply, U. S. Army, *Chicago, Ill.;*

LIEUT. COL. G. D. DEARLOVE, treasurer, Chicago Post, A. O. A., and general auditor, International Harvester Company, *Chicago, Ill.;*

CAPT. J. M. P. WRIGHT, U. S. N., Ret., staff consultant for A. O. A. Post operations, *Washington, D. C.;*

COL. F. W. PARKER, JR., director, Chicago Post, A. O. A., and partner, Parker & Carter, *Chicago, Ill.;*

COL. CARL M. SCIPLE, chief, Chicago Procurement Office, Corps of Engineers, U. S. Army, *Chicago, Ill.;*

E. J. BUSH, director, Chicago Post, A. O. A., and president, Diamond T Motor Car Company, *Chicago, Ill.;*

FRED G. ARKOOSH, secretary-treasurer, Nebraska Post, A. O. A., and vice-president, Wilkinson Manufacturing Company, *Omaha, Nebr.;*

MARK BROWN, director, Chicago Post, A. O. A., and president, Harris Trust & Savings Bank, *Chicago, Ill.;*

COL. ROBERT K. HASKELL, chief, Chicago Ordnance District, *Chicago, Ill.;*

HENRY P. ISHAM, director, Chicago Post, A. O. A., and president, Clearing Industrial District, *Chicago, Ill.;*

LIEUT. GEN. WILLIAM B. KEAN, commanding general, United States Fifth Army, *Chicago, Ill.;*

LIEUT. GEN. LEVIN H. CAMPBELL, JR., president, American Ordnance Association, *Washington, D. C.;*

HON. JOHN SLEZAK, Assistant Secretary of the Army, *Washington, D. C.;*

LIEUT. COL. WM. G. SWARTCHILD, JR., vice-president, Chicago Post, A. O. A., and vice-president, Swartchild & Company, *Chicago, Ill.;*

MAJ. GEN. E. L. CUMMINGS, Chief of Ordnance, United States Army, *Washington, D. C.;*

COL. LEO A. CODD, executive vice-president, American Ordnance Association, *Washington, D. C.;*

JAMES KNOWLSON, director, Chicago Post, A. O. A., and chairman of the board, Stewart-Warner Corporation, *Chicago, Ill.;*

BRIG. GEN. W. E. LAIDLAW, commanding general, Ordnance Ammunition Center, *Joliet, Ill.;*

E. S. HIGGINBOTHAM, director, Chicago Post, A. O. A., and president, Tokheim Oil Tank & Pump Company, *Fort Wayne, Ind.;*

BRIG. GEN. NORMAN E. WALDRON, commanding general, Quartermaster Market Center, U. S. Army, *Chicago, Ill.;*

GLEN LLOYD, director, Chicago Post, A. O. A., and Partner, Bell, Boyd, Marshall & Lloyd, *Chicago, Ill.;*

WALDO B. AMES, president, Illinois State Chamber of Commerce, and partner, Moore, Case, Lyman, and Hubbard, *Chicago, Ill.;*

LIEUT. COL. H. J. PREBENSEN, vice-president, Chicago Post, A. O. A., and president, Air Comfort Corporation, *Chicago, Ill.;*

COL. ROBERT L. FINKENSTAEDT, chief, Chicago Air Procurement District, United States Air Force, *Chicago, Ill.;*

W. E. CROCOMBE, director, Chicago Post, A. O. A., and assistant chairman of the board, American Forge Division of American Brake Shoe Company, *Chicago, Ill.;*

J. R. MUNRO, president, Central Illinois Post, A. O. A., and president, Caterpillar Tractor Co., *Peoria, Ill.;*

LIEUT. COL. JAMES KARRAKER, director, Chicago Post, A. O. A., and vice-president, Northern Trust Co., *Chicago, Ill.*

Preceding the dinner meeting, members were privileged to visit the Glenview Naval Air Station under command of Capt. Ford N. Taylor. The afternoon was most instructive and enjoyable. This session included an excellent movie depicting the history of jets. Entitled, "The Jet Story," the film was made by General Electric Company and traced the jet principle from its very beginning at the start of the century to the present and latest jet aircraft.

Quad Cities-Iowa Post Visits Rock Island Arsenal, Hears Admiral Austin

The Quad Cities—Iowa Post held its fall meeting at the Rock Island Arsenal, Rock Island, Ill., on November 20, 1953.

The guest of honor and principal speaker was Rear Adm. B. L. Austin, director, International Affairs Division, Office of the Chief of Naval Operations.

Admiral Austin was entertained at luncheon at the Rod and Gun Club in the Blackhawk Hotel in Davenport. P. S. Mumford, president of the Quad Cities Post, was host.

Post members visited Rock Island Arsenal in the afternoon.

Shortly before the evening meeting Admiral Austin appeared for a brief question-and-answer period on television from Station WAFB in Rock Island.

The dinner meeting was held in the large restaurant at the Rock Island Arsenal through the kindness of Col. W. W. Warner, the commanding officer of the arsenal.

Mr. Mumford presided at the speakers' table and introduced the following leaders: Admiral Austin; Colonel Warner; Col. C. D. Wiman, founding president of the Quad Cities Post; A. Linton Lundy, Jr.; Donald L. Meyers, secretary-treasurer of the Post; and Capt. J. M. P. Wright, U. S. N., Ret., from the Washington headquarters of the American Ordnance Association.

Mr. Mumford and Captain Wright made brief remarks on the aims and purposes of the Association.

The first talk by Mr. Meyers gave Post members a preview of the predicted development schedules for rocket travel, starting with early capabilities, through the first phase of establishing orbital stations, and then final rocket travel.

Mr. Meyers and his group of astronautical enthusiasts predicted that we should be able to reach the moon in about sixty years.

In the principal address, Admiral Austin compared the dangers of pioneer days with those of today and pointed out the need for steadfastness in meeting the present dangers and for clear thinking to obtain a happy balance between a sensible defense and a powerful offense.

After his formal speech he answered many questions from the audience on international affairs that ranged from the size and strength of the Soviet Navy and the economic balance of power between the free world and the Communist world to the trend of affairs in Iran.

Board of Directors of San Francisco Post Meets at the Pacific Union Club

The board of directors of the San Francisco Post met at the Pacific Union Club on September 16, 1953.

The meeting was called to order by President B. C. Heacock at 12:15 p.m.

The following board members were in attendance: Lawrence Fletcher, G. M. Greenwood, Adm. George Murray, Edgar B. Jessup, and Jean Witter.

Also present were Col. John M. Stark, the Post's senior counselor, and Capt. M. W. Harris, secretary-treasurer.

Mr. Heacock brought to the attention of the board the fact that four board memberships would expire on December 31, 1953. Methods of electing their successors were discussed. It was proposed that all members participate in the election and that it should be conducted by mail ballot.

Mr. Witter was selected as chairman of a committee to present nominations and to conduct the election.

Mr. Heacock requested that a complete list of active members be furnished him by the secretary of the Association. A campaign is to be initiated for an increase in membership, with Mr. Greenwood as chairman.

The following suggestions were made by the directors to arouse interest in new members:

1. Contact those present at the meeting in honor of General Cummings.

2. Contact old members who have dropped out.

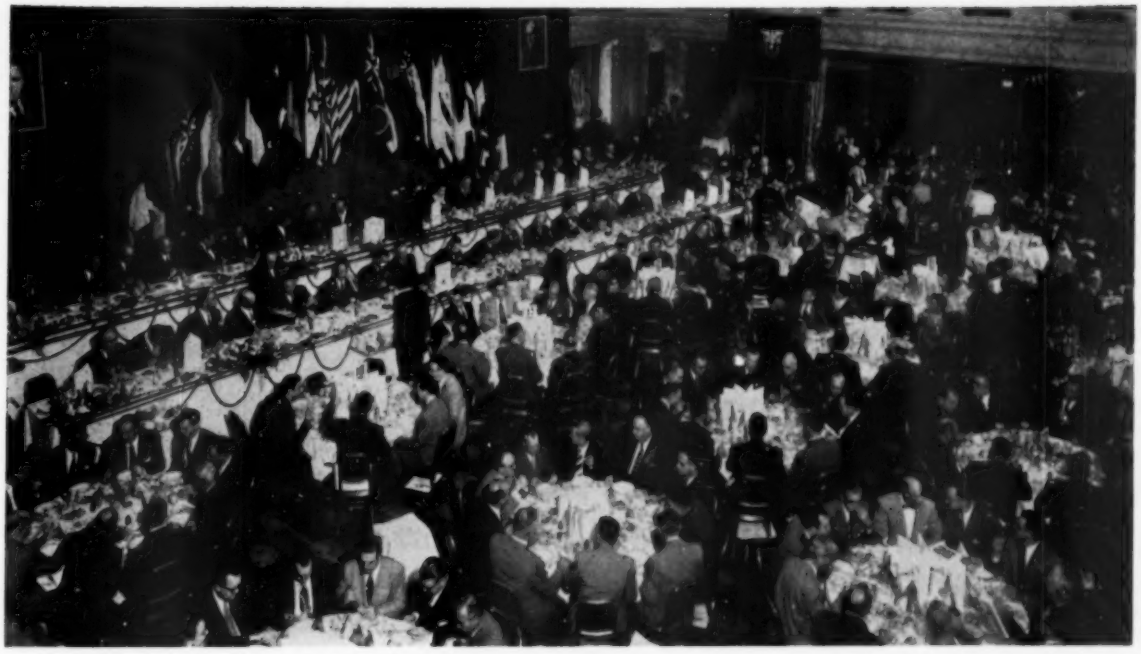
3. Contact personnel of San Francisco Ordnance District contractors.

The president was asked to invite Senator William F. Knowland to be the guest speaker at a meeting at the earliest possible date. Mr. Fletcher was asked to assist in communicating with the Senator.

The action of the president in appointing Miss Barbara Lou Noia as acting secretary was ratified and confirmed.

The president stated that he had been unable to locate any by-laws of the Post, although the Post constitution provides that the board shall adopt a set of by-laws. He asserted that he would attempt to obtain a typical set as employed by other Posts and would present them at a future meeting.

Comments were made regarding the luncheon meeting arranged by the regional vice-president, Col. Dean Witter, for Lieut. Gen. L. H. Campbell, Jr., president of the Association, and the directors of the Post.



General view of the grand ballroom at the Hotel Statler during annual dinner meeting of the Cleveland Post.

Gen. Matthew B. Ridgway Is Principal Speaker at Meeting of Cleveland Post

The Cleveland Cadillac Tank Plant was the scene of the first session of the annual meeting of the Cleveland Post of the Association on the afternoon of November 10, 1953. With Gen. Matthew B. Ridgway, Chief of Staff, United States Army, as the guest of honor, the more than 250 members of the Post who toured the plant were given an excellent opportunity to study the latest mass-production methods as applied to one of our principal weapons for the armed forces of the United States.

The General was escorted by A. J. Weatherhead, president of the Weatherhead Company of Cleveland and president of the Cleveland Post, and Harold R. Boyer, general manager of the plant who arranged the visit.

The 2-hour tour of the plant led the spectators along the assembly line where the Walker Bulldog Tank is produced. The inspection concluded with a full demonstration by six tanks maneuvering on the test track of the plant. The T42 with its special gun mount on the Walker chassis was shown for the first time.

The guests were escorted through the plant by Cadillac guides. They assembled at points along the inspection route to listen to explanations of operations given by engineers over loud-speakers. Chartered buses transported the visitors from the Statler Hotel in Cleveland to the plant, which is located adjacent to the Cleveland Airport.

This tour preceded the annual dinner meeting of the Post which this year honored General Ridgway. A total of 700 members and guests attended the banquet held in the Hotel Statler. The presentation of the General Benedict Crowell Gold Medal for service in the cause of national defense was made to General Ridgway, and the medal was presented by Charles M. White, president of Republic Steel Corporation and a director of the Post. General Ridgway's address on "Man—the Ultimate Weapon" is published in full on page 574 of this issue.

Mr. Weatherhead, presided at the dinner meeting and Frederick C. Crawford was toastmaster. The invocation was given by Lieut. Col. L. M. Wolf, Chaplain, 83rd Infantry Ohio Division.

J. E. Trainer, Firestone Tire & Rubber Company, Akron, Ohio, reported on the activities of the Post, and William I. Ong, American Steel & Wire Company, reported on post membership.

Considerable interest was engendered throughout the city by Mayor Anthony J. Celebrezze, who issued an official proclamation declaring Tuesday, November 10, 1953, "General Matthew B. Ridgway Day" in Cleveland.

The directors of the Post who, with General Ridgway, assisted in receiving the large number of guests are: Robert F. Black, Harold R. Boyer, George C. Brainard, Ward M. Canaday, Fred H. Chapin, Mr. Crawford, William H. Forster, Jr., Clyde T. Foster, John A. Greene, Ben F. Hopkins, Adrian D. Joyce, Herbert P. Ladds, William G. Laffer, John C. McHannan, Albert M. Miller, Walter F. Mumford, Mr. Ong, Thomas F. Patton, W. S. Richardson, H. A. Roemer, Jr., Herman F. Safford, A. W. Steudel, Charles J. Stilwell, E. J. Thomas, W. Robert Timken, Mr. Trainer, William A. Weaver, Charles M. White, Dr. Clyde W. Williams, and Seward A. Covert.

• **AT ABERDEEN.**—Earl D. Johnson, Under Secretary of the Army, was the principal speaker at a dinner meeting of the Aberdeen Post at the Glenn L. Martin Plant near Baltimore, Md., on December 2, 1953. His remarks expressed concern about the future of the helicopter industry and the means and ways of bolstering it.

Speaking before some 300 members of the Association, Mr. Johnson called attention to the length of time—around six years—necessary to develop an airplane from the experimental to the production stage and declared:

"The helicopter industry cannot starve while waiting to obtain a Government order six years from now."

Mr. Johnson, whose after-dinner address to the Association was preceded by a tour of the Middle River aircraft plant, gave no hint of how governmental officials proposed to strengthen the helicopter industry but said that the subject was discussed continuously in the Department of Defense and in the upper echelons of the Air Force.

The Army was particularly concerned,

he said, because its "future plans revolve around the use of the helicopter on a broad scale."

One possible use of the machine, which can proceed vertically as well as horizontally, he continued, was as a replacement for the old Army pack mule.

He explained that in Korea native bearers were used rather than the pack mule, adding that, although this human substitute was very efficient and could carry as much as 200 pounds up and down the steep hills, a helicopter could even go places the bearers could not go.

They were, for example, he said, especially useful in transporting the wounded to hospitals far behind the lines.

"Time after time in the Tokyo hospital I saw men who had been wounded only the day before," Mr. Johnson said. "The men were better soldiers because they knew that, if wounded, they would receive the best of treatment."

Because of these and other functions, Mr. Johnson declared, the Army in the future would probably use more helicopters than "the other two services combined."

In his speech, which was heard by his son, Raud Johnson; Maj. Gen. J. L. Holman, commanding general at the Aberdeen Proving Ground; and high officials of the American Ordnance Association and of the Martin Company, Mr. Johnson paid homage, not only to the helicopter but to air power in general.

Capital Cities Post Members Visit American Locomotive Company Plant

A meeting of the Board of Directors of the Capital Cities Post was held at the Locomotive Club, Schenectady, on October 14, 1953. A general membership meeting on the same day began with an afternoon tour of the manufacturing and testing facilities of Alco and ended with a dinner at the Locomotive Club. About 200 persons attended.

Vice Adm. Willard A. Kitts, III Post president, presided. Those present at the meeting included Col. R. Z. Crane, C. E. Smart, J. O. Amstuz, Ray Stearns, R. L. Fryer, E. H. Haller, E. D. Rhodes, and Committee Chairmen Eloan, Booth, and Schurig.

Colonel Crane's offer to sponsor the spring meeting at Watervliet Arsenal was accepted.

The current drive to increase membership in the Association has assigned the Capital Cities Post a quota of 270 new members.

At a recent committee meeting attention was devoted to the possibility of forming a student chapter at Union College, similar to such chapters at other colleges, or in some other way attracting students in near-by colleges to affiliate with the Post. It was noted that Siena College is growing and should be considered later.

In view of the interest of a number of men at the General Electric plant in Pittsfield in attendance at Capital Cities Post meetings, the question was discussed whether it would be possible for them to be affiliated with the Capital Cities Post, instead of the Springfield Post which has jurisdiction over the Pittsfield area of the Association.

The suggestion was made that these people might be canvassed with regard to their preference concerning affiliation with the Capital Cities Post.

A final checkup before the meeting showed an increase of thirty new members. Present membership is 438 regular and 7 company members, plus 48 student members, a total of 493, an all-time high. Applications are coming in at an increasing rate.

President Kitts proposed that a medal or other recognition be given for contributions to Ordnance by students. Professor Booth recommended that such an award be made a permanent institution and that the individual award be at a cost of about $20.

Mr. Amstuz recommended the formation of an Award Committee which would be empowered to obtain funds and to finance the activity in regard to such awards from year to year.

On the motion of Mr. Stearns, seconded by Mr. Amstuz and approved, an Awards Committe was authorized, to consist of Professor Booth, Mr. Amstuz, and Mr. Rhodes.

President Kitts proposed that this committee prepare a set of recommendations and send them to the Post secretary who will then prepare a mail ballot for presentation to the board of directors. This will be done as soon as possible.

Professor Booth reported that, despite the illness of Mr. Sanders, chairman of the committee to work with high schools, a meeting is contemplated in the near future. These meetings have been held at the General Electric Company and at Watervliet Arsenal in the past.

At the general membership meeting that same evening, Col. Jean E. Engler, chief of the national production planning division, Ordnance Tank Automotive Center, Detroit, said the long-haul basis of production would permit tank-producing companies to maintain output on a steady level.

• **AT WASHINGTON.**—Since the December meeting coincided with the grand finale of a year-long celebration of the fiftieth anniversary of powered flight, the Washington Post was exceptionally fortunate in having as its speaker at the National Press Club on December 17, 1953, the first man in the U. S. Armed Services who flew a jet plane.

He is Lieut. Gen. Laurence Carbee Craigie. General Craigie pioneered U. S. jet flight by piloting the XP-59 on its initial flight at Muroc Dry Lake, Calif., in October 1942.

General Craigie is now Deputy Chief of Staff for Development of the Air Force. He spoke on ordnance problems encountered in connection with the Air Force program.

A graduate of the U. S. Military Academy, General Craigie received his flight training at Brooks and Kelly Fields in Texas and later became an instructor at both fields, as well as at France Field, Canal Zone, and served as flight commander at Randolph Field.

During World War II, General Craigie served in North Africa as commanding general of the 12th Air Force's 63rd Fighter Wing, as chief of the Engineering Division of the Air Technical Service Command at Wright-Patterson Field, and as chief of the Research and Engineering Division at Air Force Headquarters in Washington.

Among his many other tours were his service as vice-commander of the Far East Air Force in Tokyo in 1950 and as Air Force member of the United Nations truce delegation in Korea.

He was assigned to his present duties in November 1951.

• **AT WATERTOWN.**—Members of the Yankee Post followed up their 2-day cruise with a Navy fast carrier task force on November 3-4, 1953, with their fall meeting on November 5th.

Watertown Arsenal was host to Post members with a schedule that included a visit to the arsenal's shops, refreshments at the Officers' Club, dinner at the post mess, and a symposium on "Lowering Costs to Meet Competition."

Col. B. S. Mesick, commanding officer at Watertown Arsenal, had placed on display the Magic X and Raytheon's ultrasonic machines. The type of work that can be produced on these ingenious pieces of equipment has to be seen to be appreciated.

The 280-mm. gun designed at Watertown, with its prime movers, was exhibited in an outside park.

From there the small parties into which the group was divided proceeded through the welding shop, the 280-mm. projectile line, the gage laboratory, and the centrifugal casting foundry. The 280-mm.

Maj. Gen. E. L. Ford, left, the Army's nineteenth Chief of Ordnance, gives his final salute after 36 years' military service during a retirement review at Fort Myer. He is accompanied by Lieut. Gen. W. B. Palmer, Assistant Chief of Staff, G-4.

projectiles appeared to be rolling off the line in an efficient manner, and the group was on time to see a 75-mm. barrel being drawn out of the casting furnace.

At the dinner meeting the new officers of the Post were elected, including Helge Holst of the Arthur D. Little Company, who was elected president to succeed Harry A. Wansker of United-Carr Fastner Company.

Mr. Holst spoke briefly of future Post activities and Mr. Wansker received rousing applause and a vote of thanks from all the members for his energetic leadership and splendid planning while president.

The symposium was ably directed by Dr. Joseph Harrington, Jr., assistant director of research, United Shoe Machinery Company. He introduced the subject for the evening, "Lowering Costs to Meet Competion," outlined the frontiers for the discussion, introduced the speakers, and directed questions to the proper speakers, all in a smooth and skillful manner.

L. D. Miles, manager of the value analysis unit, General Electric Company, Schenectady, presented several fascinating pieces of evidence to illustrate how G. E. had saved many thousands of dollars by small changes in the design or specifications of current equipment. He showed several examples where utilizing stock bolts with rolled threads saved his company fifty per cent on costs with no loss in quality.

Mr. Brown, loan manager of the First National Bank of Boston, delivered a complete report of the numerous means available to the small-business man to make the most effective use of his credit.

Paul D. Wilson, procurement director of the Raytheon Company, told how costs may be lowered by achieving cordial and understanding relations with suppliers.

During all three talks it was observed that many in the audience were making notes and nodding their heads in agreement over the numerous useful ideas that were brought out in the course of the entire symposium.

Colonel Mesick closed the session by a brief address that outlined the methods used by the arsenal to keep down costs for the benefit of taxpayers.

This was a most interesting meeting and fitted well the criterion stated by G. P. Slade, a previous president of the Yankee Post, as to what type of meetings should be conducted—"only such meetings as will be outstanding successes."

• **AT WEST POINT.**—This year's president of the United States Military Academy Ordnance Club is Cadet T. C. Brown, Company K-2, U. S. Corps of Cadets.

Cadet Brown manifested a keen interest in all phases of Ordnance during the past two years and worked untiringly to set up an interesting program for the Club.

The following letter was set by Lieut. Gen. L. H. Campbell, Jr., president of the Association, to Cadet Brown:

"On behalf of the officers and directors of the American Ordnance Association, I am pleased to tell you that you have been awarded an honorary membership for one year in the Association in recognition of the splendid contribution you have made, and are making, as president of the Cadet Ordnance Club.

"The Club is carrying forward the progressive ideals which have characterized Ordnance thinking in the United States over many years. The leadership of Maj. Gen. William Crozier, Chief of Ordnance, 1901-1918, and his successors, continues as an abiding inspiration to us all.

"Please convey to your fellow members of the Club the felicitations of our national board and assure them that the Club will always be highly regarded for its fine interest in Ordnance. Added to the above, go special wishes for its continued success."

Cadet Brown replied as follows:

"I would like to thank you very much for the honorary membership in the American Ordnance Association. It was one of the most wonderful things that has happened to me.

"The Ordnance Club sincerely appreciates the high regard and the special wishes from your Association for our continued movement."

• **LOUIS POLK**, president of the Sheffield Corporation, Dayton, Ohio, has been named a director of the American Society of Mechanical Engineers.

In addition to important responsibilities with industrial and financial concerns, Mr. Polk has long been active in engineering and national-preparedness activities.

He is a director and vice-president of the American Ordnance Association, a member of the Society of Automotive Engineers, a permanent director of the American Society of Tool Engineers Research Fund Committee, a member of the American Gage Design Committee of the U. S. Bureau of Standards, and a member of the Government Relations Committee of the National Machine Tool Builders Association.

• **NEW PUBLICATIONS.**—Two new publications have just been issued by the Association. The first is the 1954 edition of the annual directory which lists the members of the A. O. A. Council, Board of Directors, and Executive Committee; the national officers and Advisory Board; the officers and directors of all local Posts; and the members of the Technical Divisions and Committees.

The new directory also features an organization chart of the National Association and an Honor Roll listing the Company Members of the A. O. A. The directory is being mailed to all members as Section II of this issue of ORDNANCE.

Also recently completed is a new and revised edition of the roster of life members of the Association. This roster, in

attractive brochure form, has been sent to all life members of the A. O. A. Any other member who wishes to receive a copy may have one upon request to the Editorial Offices.

The life membership fee is $100, and all regular members who are interested are invited to write for further information. Not only does this type of membership insure the uninterrupted reception of all the publications and privileges of the Association for life, but it is likewise a pledge of continuing support to the A. O. A. in its work for peace through strength.

• **A MAGNIFICENT COLOR FILM** of the Thirty-fifth Annual Meeting of the Association held at Aberdeen Proving Ground, Md., on October 8, 1953, has been prepared under the direction of Col. G. B. Jarrett, curator of the Ordnance Museum at Aberdeen, and is now ready for loan to Posts.

This is a 16-mm. sound film and includes a descriptive commentary.

The film runs about fifty minutes and is especially appropriate for showing as the feature attraction of a Post meeting.

• **REAR ADM. WILLIAM STERLING PARSONS,** Deputy Chief of the Bureau of Ordnance, United States Navy, and nationally known for his outstanding achievements in the development of the proximity fuze and atomic weapons, died unexpectedly at Bethesda Naval Hospital on December 6, 1953, while undergoing a physical checkup.

He was the leading engineer-scientist of the Navy's officer corps as well as a skilled executive, and had been concerned directly with the development and use of atomic weapons since he joined the Manhattan District during World War II.

While Los Alamos was still a small group of temporary buildings, Admiral, then Captain, Parsons was attached to Dr. Oppenheimer's team to supervise the development of the mechanical features of the bombs used on Japan. Not content with engineering the bombs, he flew with the mission that bombed Hiroshima, readied the bomb at an advanced base, and made the final adjustments while approaching the target in the bomb bay of the attacking B-29.

Prior to his activities in the nuclear-weapons field, he participated in the development of proximity fuzes and radar for fire-control applications. After working closely with the laboratories and manufacturers, Admiral Parsons accompanied the first shipment of proximity fuzes to our fleet in the South Pacific to make certain that they were correctly used and adequately safeguarded.

Admiral Parsons was born in Chicago in 1901, was graduated from the United States Naval Academy in 1922, and completed the three years' ordnance engineering postgraduate course in 1930. He was made a rear admiral in 1946. He commanded Cruiser Division Six, Atlantic Fleet, but due to his great ability and knowledge in nuclear weapons and other scientific fields, his services were in great demand in such duties as deputy commander for technical matters at the Bikini and Eniwetok atomic weapons tests, Director of Atomic Energy in the Navy Department, member of the Military Liaison Committee with the Atomic Energy Commission, and later Deputy Director of the Weapons System Evaluation Group that studies the applications of modern weapons to strategy for the Department of Defense.

Admiral Parsons was awarded the Distinguished Service Medal for his meritorious service and devotion to duty in connection with the A-bomb development and the Silver Star for his exploits in dropping the Hiroshima bomb. He received an honorary doctorate in philosophy from the University of Rochester.

He will be mourned by his many friends and admirers in all the services, the scientific world, and the American Ordnance Association. The Navy and the Nation have lost a clear-thinking and resolute leader.

• **COL. WINTHROP WITHINGTON,** a life member of the American Ordnance Association, one of the founders of its Cleveland Post, and a former chief of the Cleveland Ordnance District, died at his home in Cape Cod, Mass., September 5, 1953.

He was a business executive of high attainments whose interest in industrial-mobilization planning was expressed with firm conviction during the years between the two World Wars. As Chief of the Cleveland Ordnance District in those days he contributed his talents in directing the forces of industrial preparedness in the Cleveland area during the 1930's.

Colonel Withington was born in Jackson, Mich., and was educated at Phillips Academy and the University of Michigan. When the Withington-Cooley Manufacturing Company of Jackson was merged with the American Fork & Hoe Company, he became a director of the latter organization and served in various positions with it until 1926 when he became vice-president and manufacturing director. He was also chairman of the board of the Sparks-Withington Company of Jackson.

A close associate of the late Col. Frank A. Scott, whom he succeeded as Chief of the Cleveland Ordnance District, Colonel Withington was one of a group of Clevelanders, led by Newton D. Baker and Benedict Crowell, who helped direct industrial mobilization in the First World War and from whose efforts grew the Ordnance Association as a symbol of industrial preparedness.

• **THEODORE F. STRAUB** died unexpectedly at Fort Jay Station Hospital, Governors Island, N. Y., on November 27, 1953.

Full military rites for Colonel Straub were held at Arlington National Cemetery, Arlington, Va., on December 1st.

Colonel Straub, Deputy Ordnance Officer of the First Army, came to Fort Jay in January 1952, from Yokohama, Japan, where he commanded the Ordnance Base Depot.

Born in Brooklyn, he was graduated from the U. S. Military Academy at West Point in 1922. During World War II he served as an assistant professor in the Ordnance Section of the Academy.

Colonel Straub was planning to retire from active duty on December 31, 1953.

• **ARTHUR B. REED,** of Troy, N. Y., died Suddenly at Samaritan Hospital on November 16, 1953, after he had been stricken ill at his home.

Mr. Reed was employed in the engineering department of the American Locomotive Company at Schenectady.

He was born in Claremont, N. H., and moved to Troy fifteen years ago. He was a veteran of both World Wars, having served as a first lieutenant in the Coast Artillery and having been wonded in World War I.

Mr. Reed was a valued member of Capital Cities Post of the Association, and he will be missed by his many friends and associates.

• **STEVENSON FINDLATER,** assistant to the president of United States Steel Corporation's National Tube Division, died from injuries received when struck by an automobile, November 20, 1953. He was a technical adviser to the Sun Forging Committee of the Artillery Division of the A. O. A.

A native of San Angelo, Tex., Mr. Findlater first joined U. S. Steel at the National Tube Division's Ellwood City, Pa., works as an apprentice engineer. He was transferred to the Pittsburgh general office in October 1929 as a seamless pipe engineer in the operating department.

He was promoted to superintendent of the seamless pipe mills at the company's National Works, McKeesport, Pa., on January 1, 1930, returning to the Pittsburgh offices in 1936 as a process development engineer. On December 1, 1943, he was appointed assistant to the president.

Mr. Findlater was a graduate of the New Mexico Military Institute and the Massachusetts Institute of Technology.

ENGINEERING MATERIALS PROGRESS

George S. Brady

PLASTICS unquestionably hold the spotlight at the moment in the realm of industrial materials offering the greatest number of new types and new applications. The word plastics, however, is a generic term almost too broad to have any more specific meaning to a product designer than the word "metals," for there is almost as much difference in composition and physical properties among the plastics as there is among the metals.

The impact of synthetic fibers, which are in reality plastics, on the textile industry is easily measured and quite well known in quantity and in dollar volume, but the impact of plastics on the metals markets is highly complicated and has seemingly been given little study. One thing is certain, however—that the replacement of metals by plastics has been at an accelerated rate since the war.

• New materials with unique properties are constantly being developed for industrial and military uses, and new processes and applications are being found for familiar materials. A knowledge of these developments is of such importance to the members of the Science-Industry-Ordnance Team that this department is being published as a regular feature of ORDNANCE.

• Colonel Brady, who compiles and edits the data, is a recognized expert on industrial materials and a consultant on this subject. He is the author of "Materials Handbook"—universally accepted as an authentic sourcebook of materials information.—THE EDITORS.

THE first plastic truck tank for transport of chemicals has been built by the Carl N. Beetle Plastics Corporation and is now in service. The tank is oval-shaped, holds 3,400 gallons, and weighs only 7,025 pounds, or 3,600 pounds less than a comparable steel tank. It is made of glass-fiber-filled Laminac, a polyester resin of American Cyanamid Company. The cost is about one-third that of a stainless-steel tank. It requires no lining or finishing, and leaks or damages are more easily repaired than in steel.

A feature of the new plastic truck bodies of the Seaboard Plastics Development Company, besides big savings in weight, is that the sides and roofs are translucent to let light into the trucks for more easy arranging and sorting of cargo. The material is U. S. Rubber's Vibrin polyester resin reënforced with glass fiber. The 24-by-8-foot body is molded in four sections, front, roof, and two sides.

Glass-fiber-reënforced polyester is the favorite material for structural plastic sheets, and the chemical industry estimates that 38 million pounds of the resins are going into the production of reënforced plastics this year, an increase of 425 per cent since 1950. This amount of resin is capable of replacing more than 300,000 tons of metals, although a considerable amount is replacing wood.

Polyester is not a single resin but is the name of a great family of resins made from vegetable oils and petroleum chemicals. They have a wide variety of physical characteristics, but most of them have high adhesive strength and toughness and are thus valued for laminates.

The possible varieties of polyester resin are practically unlimited, and new types are coming on the market with frequent regularity. A new series of polyesters developed by the Hooker Electrochemical Company under the name of Hetron resins have high strength, exceptional resistance to chemicals, and will withstand temperatures above 400 degrees Fahrenheit.

They are produced from pentane by first producing a complex chlorinated phthalic acid, Het acid, by an ingenious chlorination, condensation, and hydrolysis, and this acid is combined with glycols and maleic anhydride and then cross-linked with styrene.

Because of its clear color and high strength it is well suited for structural parts with glass-fiber filler. Unlike most polyesters, it has 30 per cent chlorine in the molecule.

A GLASS-FIBER-REENFORCED polyester is the material going into the new Chevrolet Corvette sports-car body, of which the Fiber Glass Body Company will produce 50 a day in 1954. The body weighs 200 pounds less than a similar steel body, and tooling costs are much lower than for a metal body.

But a new light van-type truck body, 12 feet long, being built by the White Metal Rolling & Stamping Company, is of magnesium sheet with extruded magnesium structural members. The body weighs only 850 pounds complete with double rear doors, compared with a weight of 2,200 pounds for steel.

Both plastics and metal are being combined in some new constructions. Chairs in a new line offered by the Herman Miller Furniture Company in plain and armchair designs are molded of glass-fiber-reënforced polyester with metal legs.

Strick Company is producing plastic doors for large refrigerated truck trailers to give greater refrigerating efficiency and reduce weight compared with former metal and wood doors. The structural panels are molded of glass-fiber-reënforced polyester resin, and the space between the inside and outside panels is filled with lightweight Fiberglas insulation.

Spacers are molded integrally in the plastic door shell, and the lining of the trailer is corrugated reënforced polyester plastic sheet. Total weight saving is about 1,000 pounds.

THE coupling material used on the heater ducts in the Model 340 Convair liner is glass cloth coated with General Electric's SE-101 flame-resistant silicone rubber. The ducts are designed for temperatures up to 600 degrees Fahrenheit. This silicone rubber is also offered for gaskets, seals, and insulation coatings.

Dow Corning Corporation is offering a silicone resin for making silicone foam as a heat insulator. The resin is supplied as a clear solid. A catalyst and an expanding agent are added to the molten resin which expands into a uniform unicellular structure of 8 to 24 pounds' density per cubic foot.

It has low heat conductivity and will withstand temperatures over 700 degrees Fahrenheit. For use in sheet form, the resin is foamed between two sheets of silicone glass laminate.

Epoglas, offered by Plastilight, Inc., is a new sheet laminate for use in terminal boards or as a base for etched plated circuits. It is made of glass fabric impregnated with epoxy resin (epichlorohydrin condensation product), and is copper-clad on one or both sides for etched circuits, or without the copper for plated circuits.

It has good mechanical strength and electrical properties, will not delaminate, and will withstand working temperatures to 340 degrees Fahrenheit. Sheets come

24 by 36 inches, with thicknesses from 0.003- to 0.500-inch.

Steel and wooden tote boxes are becoming things of the past in manufacturing production lines, being replaced by lighter, rustproof, and more easily cleaned plastic boxes. Now offered by the Molded Fiberglass Tray Company is a flat plastic tray with stacking legs for use in drying products in food and pharmaceutical plants.

The trays are molded of glass-filled polyester, are not affected by acids or alkalies, do not warp or dent, will withstand temperatures to 300 degrees Fahrenheit, and can be steam-sterilized.

FOR the conservation of nickel, and to obtain a plate that will be uniform, even on intricate shapes, a chemical method of nickel plating has been developed by the General American Transportation Corporation. This new Kanigen process deposits a nickel-nickel phosphide with from 5 to 8 per cent phosphorus, adhering firmly to the base metal and giving a wear-resistant surface with a hardness of about 600 Vickers.

Since the plate is deposited chemically and does not depend on the throw of an electric current, it is uniform, and its thickness can be controlled accurately. The corrosion resistance is about the same as that of pure wrought nickel.

ALCOA has recently licensed to Anodic, Inc., a new anodic process that will produce on aluminum parts a surface highly resistant to abrasion and corrosion and having high dielectric strength.

The coating is an integral part of the base metal, usually applied 0.002-inch thick above and below the original surface of the aluminum, and increasing the thickness of the part about 0.001-inch. However, the deposition can be closely controlled, and thicknesses of the hard oxide as heavy as 0.008-inch can be applied. Colors range from amber to black.

A new water-soluble baking enamel that can be thinned out with ordinary tap water to save expensive solvents and eliminate fire hazards is being marketed by Reichhold Chemicals, Inc., under the name of Hydrophen. It is a phenol-alcohol resin that imparts hardness combined with an alkyd resin to give flexibility and treated with ammonia which acts as a saponifier with the alkyd to give water-solubility.

When the water solution is sprayed on and baked for 20 minutes at 300 degrees Fahrenheit, the cured film is highly resistant to water, oils, and solvents. It is hard but flexible enough for deep pressing. The finish is being recommended for all types of industrial products.

For the possible saving of scarce strategic alloys, the M. W. Kellogg Company is now offering its highly chemical- and heat-resistant plastic Kel-F (trifluoro chloro ethylene) in the form of porous sheets and disks for filters. Pore sizes down to 5 microns are available.

The material comes in disks from ½ to 12 inches in diameter, with thicknesses of 1/16- and ⅛-inch, and in sheets 24 by 24 inches. The material will filter strong acids, alkalies, and corrosive chemicals at operating temperatures to 390 degrees Fahrenheit.

FOR the better production by powder metallurgy of dense and strong molded parts, Malone Metal Powders, Inc., has a new form of copper powder called Fernlock Dendritic copper powder. The structure of the particles is fernlike or feathery, giving a larger surface area than granular powders.

The powder has a bulking density only about half that of ordinary granular powder, and it gives a higher green strength to the moldings without the use of any lubricant.

U. S. Rubber Company has a new

Bendix Builds a Better *cable clamp* the AN3057B

Inexpensive • Efficient • Versatile

The new Bendix AN approved AN3057B cable clamp is now available. Engineered by Bendix to the highest quality standards, this cable clamp offers major design improvements. The clamping action is radial and completely eliminates wire strain and chafing by holding the wire bundle firmly in rubber. This clamp will accommodate a wide range of wire bundle sizes, but an even greater range can be handled through the use of the Bendix AN3420A accessory telescoping sleeve.

The new AN3057B cable clamp will also waterproof multi-conductor rubber covered cable on the rear of a connector, or where moisture-proof entrance through a bulkhead or into an equipment box is required.

This versatile clamp is a product of the Scintilla Magneto Division of Bendix Aviation Corporation and is a companion AN accessory to the world famous Bendix Scinflex line of electrical connectors. Write our Sales Department for details.

Outstanding Features

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- Shorter over-all length.
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TYPICAL CHARACTERISTICS

MECHANICAL DATA		ELECTRICAL DATA	
Weight	1.45 oz.	No load speed	6,500 RPM
Rotor inertia	.46 gm-cm²	Stall torque	.3 oz.-in.
Theoretical acceleration	49,000 RAD/SEC²	Maximum output	.490 W.
		Single phasing	None

DATA AT STALL	FIXED PHASE	CONTROL PHASE
Voltage (volts)	26	26
Frequency (cycles)	400	400
Current (ma.)	166	166
Power input (watts)	3.1	3.1
Power factor	.63	.63
R—ohms	98.5	98.5
X—ohms	123	123
Z—ohms	157	157

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Servo Motor in a size 23 Frame, 6 watt

TYPICAL CHARACTERISTICS

MECHANICAL DATA		ELECTRICAL DATA	
Weight	1.6 lbs.	No load speed	3,500 RPM
Rotor inertia	20.0 gm-cm²	Stall torque	7.5 oz.-in.
Theoretical acceleration	26,500 RAD/SEC²	Maximum output	6.0 W.
		Single phasing	None

DATA AT STALL	FIXED PHASE	CONTROL PHASE Series	CONTROL PHASE Parallel
Voltage (volts)	115	115	57.5
Frequency (cycles)	60	60	60
Current (ma.)	175	175	350
Power input (watts)	14.0	14.0	14.0
Power factor	0.70	0.70	0.70
R—ohms	460	460	115
X—ohms	470	470	117
Z—ohms	660	660	164

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Servo Motor in a size 15 Frame, 60 cycle, 115 volt

TYPICAL CHARACTERISTICS

MECHANICAL DATA		ELECTRICAL DATA	
Weight	7.3 oz.	No load speed	3,300 RPM
Rotor inertia	3.03 gm-cm²	Stall torque	1.45 oz.-in.
Theoretical acceleration	33,800 RAD/SEC²	Maximum output	1.23 W.
		Single phasing	None

DATA AT STALL	FIXED PHASE	CONTROL PHASE Series	CONTROL PHASE Parallel
Voltage (volts)	115	115	57.5
Frequency (cycles)	60	60	60
Current (ma.)	53	53	106
Power input (watts)	5.0	5.0	5.0
Power factor	.82	.82	.82
R—ohms	1780	1780	445
X—ohms	1240	1240	310
Z—ohms	2170	2170	542

Ketay

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U. S. Ordnance and **Aetna-Standard** have worked hand in hand for the last decade on several important contracts. Recently, we completed a large production run on a jeep mount for a 105 MM recoilless rifle. We are busy on two other long-range contracts . . . one for an anti-aircraft gun and the other for an anti-tank gun. In addition to the production, Aetna-Standard assisted in the design and pilot models on both of these items. Below you see the big Ordnance assembly floor in Aetna's Ellwood City, Pa., plant.

The big assembly floor in the Ellwood City plant is the center of activity for Ordnance work.

The Aetna-Standard Engineering Company

FRICK BUILDING

PITTSBURGH, PENNA.

Engineering Materials Progress

lower-cost reclaimed rubber in the form of a free-flowing powder, marketed under the trade name Flo-Mix. It is easier to mix than conventional slabs of reclaimed rubber and is about 75 per cent cheaper than new rubber powder. It can be used in regular rubber blends, in asphalt mixes, and in binders for cork and other materials.

Another asphalt additive, by Ruberite, Inc., for the easy adding of synthetic rubber to asphalt to improve resilience, ductility, and impact resistance of asphaltic coatings, is a coprecipitation product containing 75 per cent barium sulphate and 25 per cent styrene latex. It comes as a powder of about 5-micron particle size. Mixing 12 per cent additive and 88 per cent asphalt results in 3 per cent rubber in the compound.

NEW carboys for shipping acids and chemicals, being produced by the A. L. Hyde Company, are molded of Du Pont's Alathon plastic (unplasticized polyethylene). As polyethylene is extremely light (specific gravity 0.92), the 15-gallon carboy weighs only 12 pounds with screw cap and pouring spout. It does not need a case like a glass carboy and is made square for easy stacking and saving of shipping space.

Notable is the number of machine and tool redesigns that are going into light-metal housings. A new pistol-type electric drill of Fairchild Industries has the housing of die-cast aluminum. The new portable grinder of the Mall Tool Company weighs only 12 pounds for a 6-inch wheel and has an aluminum housing. The new Super-30 hand grinder and polisher of the Precise Products Corporation, weighing only 35 ounces, has an aluminum housing with chromium finish.

Cast aluminum in large-size plate and bar forms machined to a high surface finish with a flatness accuracy of plus or minus 0.005-inch, originally designed for the aircraft industry for jigs and fixtures, is now being offered by the Reynolds Metals Company for general use for press blocks, setup tables, and form dies.

The castings have a fine-grained structure free of internal voids and inclusions, and plates can be had 48 inches wide in lengths to 144 inches. Tensile strength of the castings is 25,000 pounds per square inch, with a Brinell hardness of 70.

An aluminum alloy of high electrical conductivity and low creep at high temperatures has been developed by General Electric for use as wire to replace copper wire for the field windings of steam turbine generators, and it is also being recommended for other electrical conductor applications where elevated temperatures are encountered. Called Cond-Al, the material is aluminum with about 0.43 per cent iron, 0.32 per cent magnesium, and 0.10 per cent silicon.

SUPERIOR Tube Company is now producing titanium metal tubing in outside diameters from 0.125- to 1.5-inch, with wall thicknesses from 0.004- to 0.187-inch, in lengths to 24 feet. While the cost per pound of the metal is high, it is valuable for conditions where a lightweight, high-strength, corrosion-resistant material is needed.

The Bentley, Harris Manufacturing Company has a new insulating tubing in 27 sizes that can be twisted and bent around difficult shapes and corners without cracking or losing its dielectric efficiency, will withstand continuous operating temperatures to 400 degrees Fahrenheit, and retains flexibility at temperatures as low as minus 90 degrees. The tubes are made of braided glass fiber coated with General Electric's SE-100 silicone rubber.

The highly resistant silicone resins are now being brought within the price range and adaptability for use in outside paints by modification with other resins. The new resin XR-807 of the Dow Corning Corporation is a silicone-alkyd modified with a drying oil and contains 25 per cent silicone. It can be pigmented by regular mixing methods, and a catalyst is added to give air-drying properties.

here's a test you can make

with a quarter

- Stand a quarter on edge directly over the spot where the BROACHING is taking place;
- remove all the required metal on a TURBINE DISC; go through the automatic cycling — repeatedly;
- *your quarter will still be standing!*

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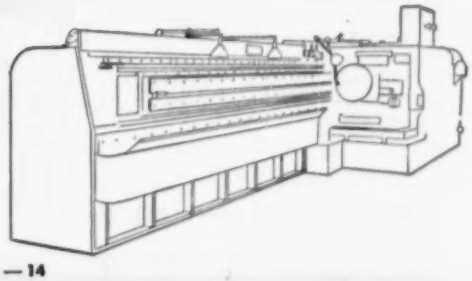
We eliminated vibration by the very weight and massiveness of this machine! Constant chatter or vibration at the cutting edge of any tool will materially shorten the life of the tool. *Eliminate vibration and you multiply the life . . . six times . . . eight . . . or even ten times!*



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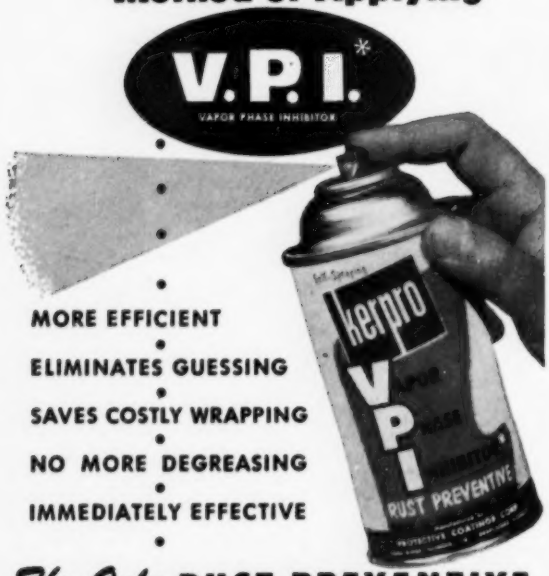

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NEW DEVELOPMENTS

FAST REMOTE-CONTROLLED TARGET

High-speed aërial targets have been ordered from the Ryan Aëronautical Company by Army Ordnance to aid in training Army troops in the operation of the Skysweeper gun and the Nike and other guided missiles. The new targets, which fly at almost the speed of sound, are remotely controlled from the ground and can maneuver at varying speeds and altitudes over antiaircraft installations—simulating invading enemy aircraft.

Officially designated the XM21, the new air target looks like a "pint-size" fighter plane. It has sweptback mid wings and tail surfaces and is approximately twelve feet wide and eighteen feet long. It will weigh about 1,800 pounds. The design incorporates a 2-stage parachute recovery system to lower each target without damage after a target run. It is powered by a Fairchild J-44 jet engine.

TURRET-TYPE GUN MOUNT FOR TANKS

Army Ordnance has recently developed a new turret-type machine-gun mount specifically designed for use on the M48 medium tank. The mount was initially designed by the Detroit Arsenal, and additional development and construction of the

Blister-type machine-gun mount on an M48 tank.

prototypes was by Aircraft Armaments, Inc., of Baltimore, Md. It was tested at the Armored Force Center, Fort Knox, Ky., and was accepted by Army Field Forces with a recommendation that it be released for immediate production. It will become a part of the tanks now being manufactured by Ford Motor Company, Fisher Body and Chrysler Corporation.

The new turret-type mount provides for all-around battlefield surveillance, aiming, firing, clearing jams, reloading, and even for replacing the gun or sight without requiring the commander to expose himself. It is effective against both enemy personnel and aircraft.

NAVY'S MEGAWATT TRANSMITTER

The Radio Corporation of America has provided the Navy with the world's most powerful radio transmitter—a stentorian telegraphic "voice" that can be heard around the world. The transmitter, located near Arlington, Wash., operates at very low frequencies (VLF), and the radio signals can be flashed to Navy establishments or ships operating in any of the seven seas. Signals will penetrate to submarines cruising below the surface and will insure reliable arctic communications despite frequent magnetic storms and ionospheric disturbances.

The gigantic project required the services of a corps of engi-

the BENDIX IGNITION ANALYZER

the only way to make a COMPLETE, POSITIVE, DYNAMIC check of the ENTIRE Ignition System . . . without removing the engine

Result tanks in action not in repair depots

Preventative maintenance is vital to the success of tanks or armored vehicles on the field of battle.

Fortunately in the case of ignition systems, incipient failure or intermittent malfunctions can be spotted immediately with the Bendix Ignition Analyzer. This provides *real* preventative maintenance.

The Bendix Ignition Analyzer gives a dynamic test of the entire ignition system in operation, outmoding time-consuming static testing of individual components. It is the easiest (checks the entire ignition system in the *field*) and the fastest (locates *any* ignition fault immediately) method of preventative maintenance ever devised for checking ignition efficiency in military vehicles of all types.

Descriptive folder available on request.

Here's How It Works —

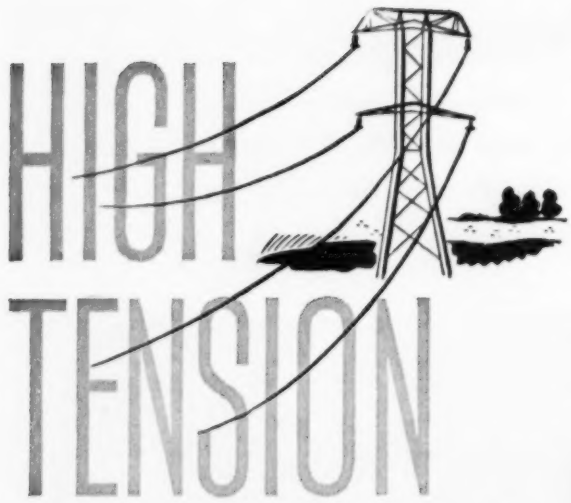
The Bendix Ignition Analyzer provides a visual picture of the *actual* voltage waveform patterns occuring at the spark plugs. Normal ignition produces a characteristic normal waveform pattern. Likewise *any* abnormal ignition condition will produce its characteristic abnormal pattern. Interpretation of the patterns identifies and locates any ignition troubles immediately.

Bendix

SCINTILLA MAGNETO DIVISION OF Bendix AVIATION CORPORATION

SIDNEY, NEW YORK

The Bendix Ignition Analyzer safeguards ignition systems in all types of military equipment.



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PRECISION BUILT to meet exacting job specifications. The cold drawn spring steel section design can be varied as required. Heavier, wider washer cross sections assure adequate reactive pressure.

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FREE SAMPLES are yours for the asking. Because of the wide range of possible uses, a mention of the contemplated application would be helpful.

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neers, some with experience dating back to the early days of wireless when all long-distance communication was by means of VLF transmission. RCA Tube Department specialists provided the super-power beam triode, the world's most powerful electron tube, for the intricate circuits of the new megawatt transmitter. Scores of draftsmen and electronic assemblers were engaged for years in the production effort.

GAGE MEASURES TEN DIMENSIONS

An automatic gage for the simultaneous inspection of 10 dimensions on an automobile piston at a rate ranging from 400 to 800 pistons an hour has recently been developed by the Sheffield Corporation, Dayton, Ohio. It does not require any special skills for efficient performance and features a pneumatic and electrically timed loading mechanism that carries the piston into and out of the gaging station. It can be loaded manually if desired.

Automatic piston-gaging device in operation.

The instrument uses colored lights to indicate whether the points of inspection are oversize, undersize, or within tolerance. When all of the dimensions are within tolerance, the master light remains white, and the nine signal lights black out. However, if one or more are out of tolerance, the master light turns red, a bell rings, and the signal lights indicate the faulty dimensions by turning red or green, indicating undersize or oversize respectively. The lights of the correct dimensions black out.

PROJECT TINKERTOY SPEEDS ELECTRONIC PRODUCTION

Details have recently been released about Project Tinkertoy, a system that will reduce the lead time required to produce new electronic equipment by seventy-five per cent. In addition, it will reduce costs, simplify maintenance, save space, and cut down on usage of several critical materials.

Conceived and developed by the National Bureau of Standards, the project has culminated in development of a machine system for manufacturing modular-type (or building-block) electron-tube stages, including the related resistors and capacitors, from basic raw materials. The machine-made modules are mechanically assembled into printed-circuit base-plate combinations, and these in turn are combined with one another and with other large-dimension basic components to form functional subassemblies.

The result is elimination of a vast amount of handwork ordinarily required to manufacture and maintain electronic gear. Previously there had been no substitute for the worker with the thin wires and soldering iron. Project Tinkertoy introduces a number of radically new machines to take the tedium and potential human error out of the job.

A pilot plant utilizing these machines has been constructed in Arlington, Va., under the technical direction of the National Bureau of Standards and will show commercial manufacturers how best to adapt the process to their own uses. It covers 15,000

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GOVERNMENT FINISH SPECIFICATIONS

and the Parker Products which meet them

This list contains specifications most frequently called for, and some of the Parker Products which meet them. There are Parker Products to meet almost every one of the less frequently used government specifications also. A letter or telephone call to Parker, Detroit, will secure specific information on products to meet government specifications not listed here.

SPECIFICATION	PARKER PRODUCTS
JAN-C-490 (Replaces AXS-1245)	
Grade I	Bonderite 100, 160, 170, 180
Grade II	
Type 2	Parco Cleaners 341, 350, 371
Type 4	Parco Cleaners 250, 260
Type 5	Parco Cleaners 210, 220
Type 6	Parco Cleaners 100, 101, 110
MIL-10578 (Formerly U.S.A. 3-213)	
Type I (Wash-off)	Parco Cleaner 250
Type II (Wipe-off)	Parco Cleaner 260
MIL-C-5541 (Formerly AN-C-170)	Bonderite 710 (chemical film for aluminum and its alloys)
MIL-C-12968 (ORD) (Supersedes in part U.S.A 57-0-2)	
Type A—(Formerly U.S.A. 57-0-2, Type I, Class A & A1)	Parco Powder, Parco Lubrite 1 & 2
Type B	
Class 1 (Formerly U. S. A. 57-0-2, Type II, Class B	Parco Compound
Class 2	Parco Compound plus Endurion
MIL-C-16232 (BuORD)	
Type I	Parco Lubrite 1 & 2
Type II	Parco Compound
PA-PD-191	
Grade I	Bonderite 32, 34, 100, 160, 170, 180
Grade II	
Type 2	Parco Cleaners 341, 350, 371
Type 4	Parco Cleaners 250, 260
Type 5	Parco Cleaners 210, 220
Type 6	Parco Cleaners 100, 101, 110
U.S.A. 72-53	Bonderite 32, 34, 100, 160, 170, 180
U.S.A. 57-0-2 [See also MIL-C-12968 (ORD)]	
Type II	
Class A & A1	Parco Lubrite 1 & 2
Class B	Parco Powder—Parco Compound
Class C	Bonderite 100, 160, 170 180

For information regarding these or other specifications, write

PARKER

RUST PROOF COMPANY

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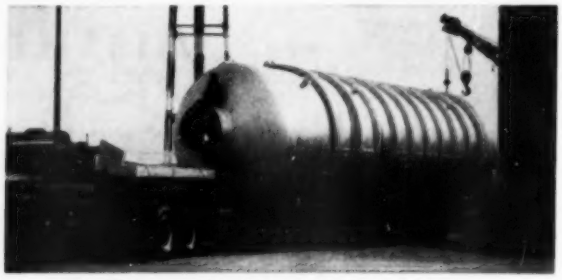
FIRST IN THE FIELD SINCE 1915

New Developments

square feet of floor space and utilizes only 35 workers. Observers will be given an opportunity to see basic raw materials, such as kaolin, barium carbonate, silver paint, and solder, fed in at various stations along a 300-foot assembly line, mechanically combined and eventually ejected at the finishing point as completed electronic modules.

NEW ALTITUDE TEST CHAMBER

Pratt & Whitney Aircraft in East Hartford, Conn., has added a 50-ton metal altitude chamber to its jet-testing equipment at Andrew Willgoos Turbine Laboratory, the country's most com-



The 50-ton test chamber arriving at the laboratory.

plete company-owned jet development facility. Designed and developed by Pratt & Whitney's experimental test-equipment engineering group, the chamber will be used to test full-scale turbojet and ramjet engines and their major components under altitude conditions.

F-100 SUPER SABRE FIGHTER AIRPLANE

Designed for supersonic speed, the Air Force's F-100 Super Sabre is the first jet fighter, scheduled for operational use, to exceed the speed of sound in level flight. Larger than most existing fighters, the Super Sabre is 45 feet long, 14 feet high, and has a wing span of 36 feet. The supersonic fighter has a service ceiling above 50,000 feet and a combat radius of more than 500 nautical miles. The North American aircraft incorporates a thin swept wing and tail and is powered by a Pratt & Whitney J-57 turbojet engine with afterburner.

In addition the F-100 design incorporates other features which provide an answer to the problems of supersonic flight. The new, heat-resisting metal, titanium, is used extensively throughout the airplane. A low-drag, ultrastreamlined fuselage and canopy with but one air intake duct help make supersonic speed possible. Other features include automatic leading-edge slats and a low-positioned one-piece horizontal stabilizer. The plane has an automatically regulated air-conditioning and pressurizing system and automatic fuel system.

RAPID X-RAY PROCESS

The first prototype unit of the newest X-ray development—Xeroradiography—is being tested by Aluminum Company of America at its Cleveland Research Division. Xeroradiography (pronounced "Zero Radiography") is an advanced technique in X-ray. It employs a reusable dry plate to record the X-ray image.

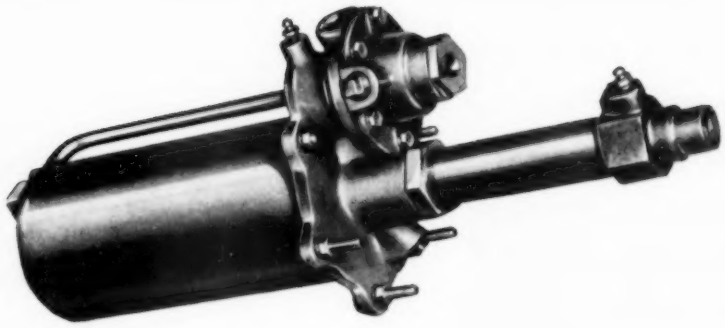
The system uses static electricity to arrange a fine-grain powder on a specially coated aluminum plate and produces an image similar to that on an X-ray film. With the new process an X-ray image is available for viewing within forty-five seconds. The conventional X-ray film requires one hour to develop and dry for viewing.

The development primarily involves the reusable plate, which is used with the conventional X-ray tube and involves no new X-ray equipment. The need for a darkroom to prepare the image is eliminated. A permanent record of the image on the plate, if

Bendix

AIR-PAK

combines the advantages of air power with hydraulic brake actuation



Here, with a single compact, easy-to-install power braking unit, truck manufacturers and operators can combine all of the well proven advantages of hydraulic brake actuation with an air brake system.

Bendix* Air-Pak changes air pressure into hydraulic pressure by means of two directly connected pistons. Thus, a non-compressible column of brake fluid instead of air connects between the driver's foot and the brake shoe. The result is faster brake action, more positive and better control.

Another important Air-Pak advantage is the fact that brakes can be applied instantly by foot power alone—an emergency standby when braking is required before air pressure builds up, or if air pressure fails for any reason.

Important, too, is the fact that Air-Pak is a product of Bendix, designer and builder of Hydrovac*, the world's most widely used power brake with over three million units now in use.

Thus Air-Pak benefits from a specialized engineering and manufacturing experience unrivaled in the automotive industry.

Descriptive folder on Air-Pak is available on request.

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Cleveland 6, Ohio

85TH ANNIVERSARY
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COMPANY

it is desired, can be made in a few seconds by photographic methods.

NEW UNDERWATER ACOUSTIC LABORATORY

The Naval Ordnance Laboratory recently announced that a floating facility for studying long-range, underwater sound-pickup devices is now in operation on a Patuxent River reservoir north of the Capital, replacing a previous one on near-by Lake Barcroft. Testing is performed from a covered barge with an enclosed well through which experimental devices can be lowered to the bottom of the reservoir. The facility is equipped to work with frequencies ranging from subaudio to high ultrasonic and will be used for testing sound projectors, hydrophones, and transducers, as well as for conducting basic research in the general field of underwater sound.

VIBRATORY GYROSCOPE DISCLOSED

A new and different kind of gyroscope was recently disclosed by the Navy to gyro experts of the military and industry. The new "vibratory gyroscope" resembles a small tuning fork in contrast with the spinning wheel of the conventional gyroscope.

The new instrument, according to the Navy Bureau of Aeronautics, is analogous to the "halteres" or gyratory sense organs found on the common house fly. These are club-shaped vibrating rods behind the fly's wings which give the fly his sense of balance.

Experimental vibratory gyroscopes consist of small electrically driven tuning forks which are sensitiye to extremely small as well as large turning motions. The experimental units can measure rates as slow as the earth's rotation to more than a hundred revolutions a minute.

RESEARCH AIRCRAFT HAS RADICAL DESIGN

The radical design of the Air Force's X-3 research aircraft, which has been under test for a year, was revealed recently. The X-3 has a slender fuselage with an extremely long, tapered nose and short wings located well back toward the tail. Viewed from above, it resembles a huge stiletto.

Length of the X-3 is 66 feet 9 inches, nearly 3 times its span of 22 feet 8 inches. The top of its tail, rising on a boom over the twin-jet exhausts, measures 12½ feet from the ground. The airplane stands on tricycle landing gear which retracts into the fuselage. Although the gross weight and length of the "flying stiletto" slightly exceed those of the familiar DC-3 transport, the X-3 wing span is less than the span of the DC-3 tail.

This is the Golden Year

First the boy; then the man.

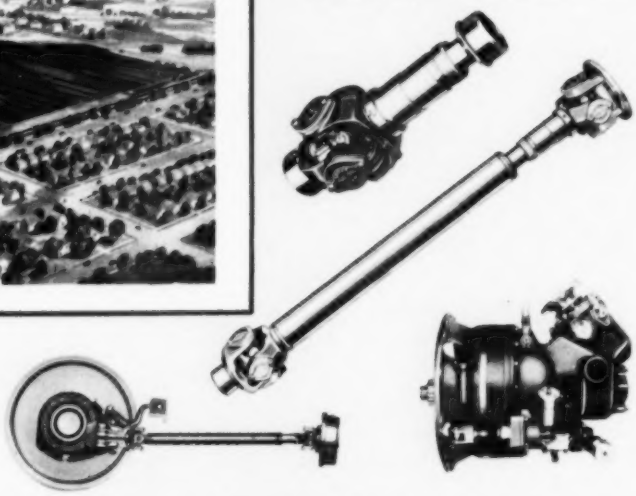
In 1904, Spicer was a new company, standing with hundreds of other companies on the threshold of America's brilliant automotive era.

In 1954, Spicer is an international economic force that has grown through 50 years of uninterrupted service to the great automotive industry.

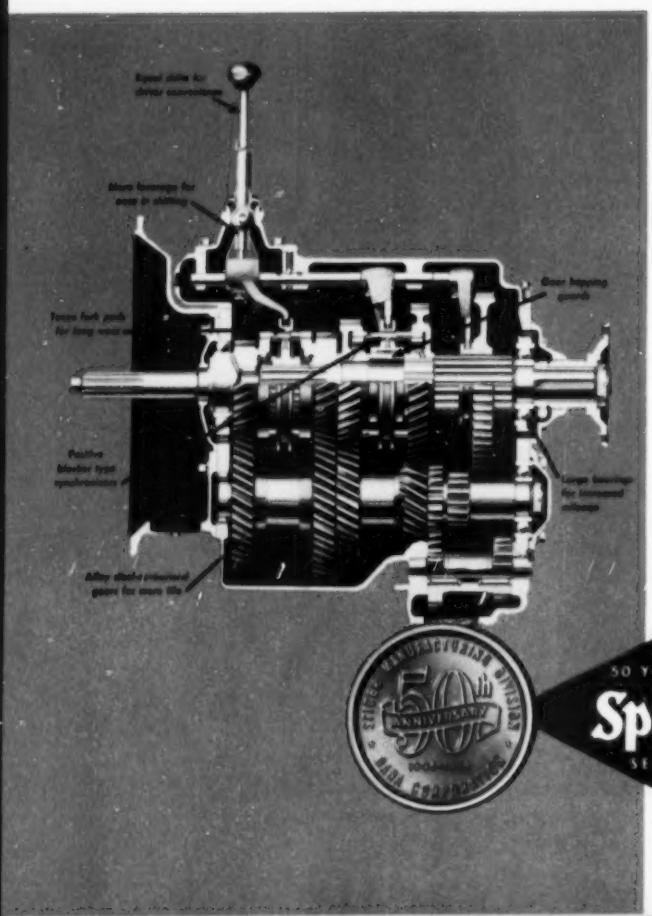
This is the Golden Year for Spicer. This is the year for projecting new plans; the year for looking forward to new horizons; the year to start building for another 50 years of golden opportunities to grow and to serve.

THIS IS SPICER IN TOLEDO, OHIO

Major products of the Toledo plant are the large sizes of the famous Spicer Universal Joints and Propeller Shafts, Transmissions, Railway Generator Drives, Torque Converters, and related materials



The Spicer Brown-Lipe Synchronized Transmission puts more productive horsepower into driving wheels



Moving more tons at less cost per mile, with increased driver comfort and efficiency, are important functions being rendered daily in thousands of Spicer Fully Synchronized Transmission applications. Its advantages include:

Fully Synchronized in All Speeds above 1st	
Faster Shifts	No Missed Shifts
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This assures:

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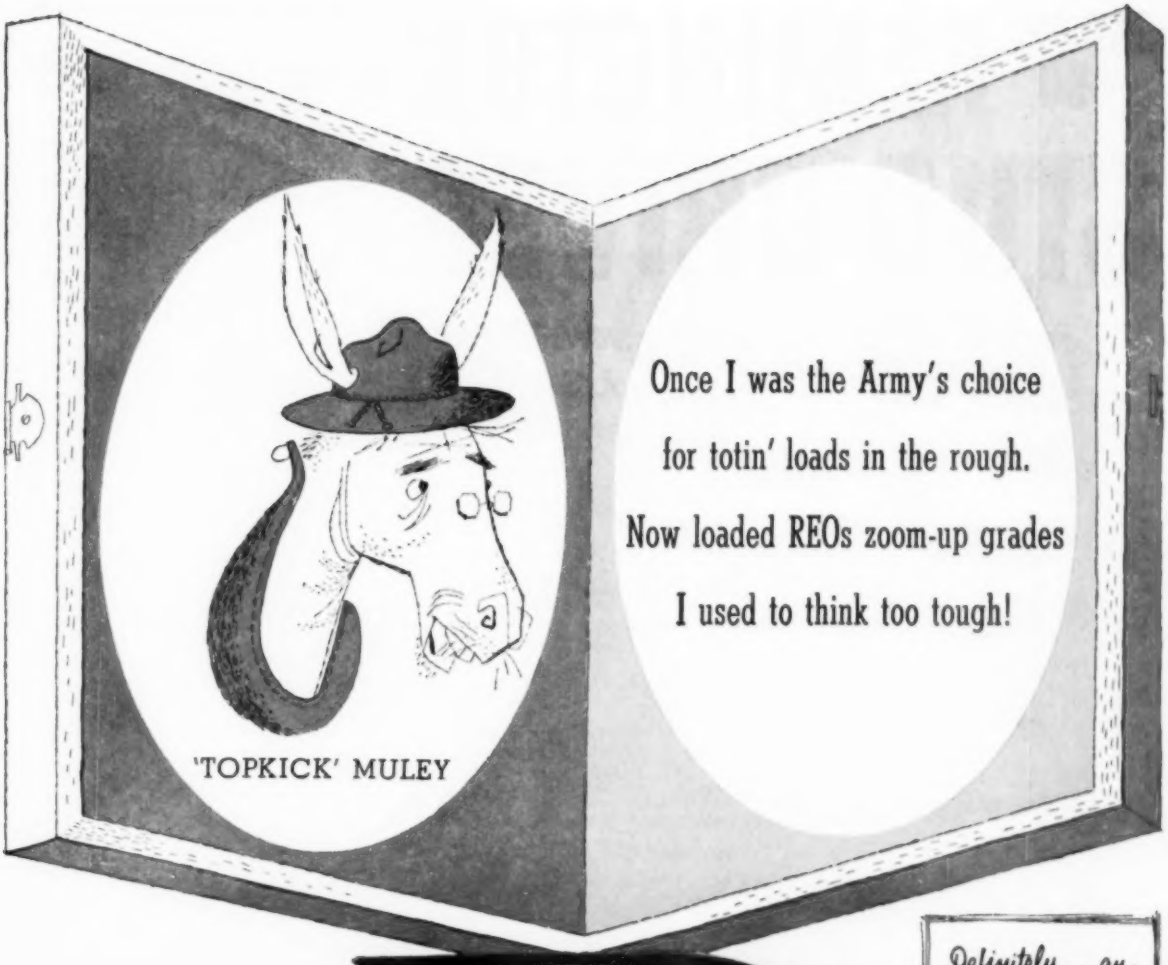
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Now loaded REOs zoom-up grades
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MAXIMUM POWER RANGE. You get a wide choice of power in Remington cartridges. They're available in six different loads, each clearly marked by colored plastic heel caps. The 32 caliber cartridge gives you extra power in this medium-duty tool . . . helps you speed all types of fastening jobs.

ARROW-STRAIGHT DRIVING—PERFECT GAS SEAL. Long heel cap on all Remington cartridges provides tight gas seal . . . gives the Model 450 more power. Assures controlled, consistently straight driving.

FAST, POSITIVE EJECTION. Exclusive ejector snaps fired case out of tool instantly—no fumbling, no tools needed.

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Test-proved to be the world's finest and speediest fastening system, the Model 450 Remington Stud Driver is made by Remington Arms Company, Inc., *America's oldest sporting arms manufacturer.*

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FROM THE RECORD

A LOOK AT RESEARCH

In setting up a method of operation for the Assistant Secretary of Defense for Research and Development, it seems clear that the existing momentum of the three services in research and development must be maintained. Rather than reorganization from the laboratory level upward, we must provide assistance and guidance to the three Departments in their research and development operations.

Without in any way diluting the ultimate responsibility and authority of the Secretary of Defense, there must be a large degree of decentralization. In the organization and operating procedures being set up, we will consider each of the three military Departments individually responsible for sound research and development programs; for programs which are realistic in relation to the state of the art and the promise of success; for programs that are sound in relation to their respective needs; and (something new has been added) for insuring that their programs are sound in relation to the programs of the other military Departments.

As a mechanism for planning and coördinating programs, we are setting up coördinating committees in each of a dozen or so main matériel areas consisting of representatives of each of the Departments involved and of my office.

These committees will be responsible for the administration of the program within budgetary limits. If they arrive at unanimous views, they will be accepted. If there is a dissent, including a dissent by the Department of Defense representative, I will have to be the referee to resolve the matter for the Secretary of Defense.

In order to benefit from the experience of civilian scientists in the planning and review of our programs, we will set up opposite each coördinating committee one or more panels of consultants selected for their professional competence in the various technical and scientific fields. While these panels will be advisory to the Assistant Secretary of Defense, they will work intimately with the coördinating committee; and those actually responsible for the programs in the Departments, seeking solutions on the working level but reporting dissents to me. . . .

Now let us look at some of the financial aspects of research and development. The Department of Defense is at present spending more money for research and development than ever before in history.

Actual expenditures for this year will be about $1,300,000,000 in support of some 8,000 separate research and develop-

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Armor Plate Office: **PENOBSCOT BUILDING, DETROIT, MICH.**

Continental's development work on gas turbines, some of which are already in production, taps a reservoir of engine experience dating from 1902. This unusual background of technical knowledge and precision manufacturing skill is now available to those requiring shaft turbines, air generators, or turbo-jets, for use in aircraft or other applications.

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ment projects. During the four years 1947-1950, the amount spent averaged $500 million a year, so we are currently spending about 2½ times the amount we did during the years just prior to the Korean war.

Such an abrupt change was inefficient. Had the situation been better understood, it could have been better planned; but our history shows that the public tends to turn away from support of the military unless there are clouds on the horizon. Now that the public seems more aware of the threat that faces us, we must be careful that we do not overdo our demands on the Treasury and become overbalanced on the other side.

THERE is one aspect of Defense research and development financing that differs considerably from the usual industrial practice: that is the large amount of money used to support activities of a research and development nature but not directly funded in the $1,300,000,000 research and development budget. For example, there are the pay and allowances of military personnel in our laboratories and test facilities which amount to about $100 million annually. There are early models purchased on procurement funds that serve development purposes. Although no exact figures have been gathered, there have been estimates that this type of support of research and development totals an additional $1 billion.

It is a challenge to use these very large appropriations wisely, and, indeed, to reduce them if this can be done without impairing our defensive strength. . . .

In recent months, particularly following the announcement of a Russian thermonuclear test, much has been said on the radio and in the press about adequacy or otherwise of our air defense of the North American Continent. In spite of all the needling, I am sure that the national interest would not be best served by having the Department of Defense enter into public debate on the technical aspects of this matter.

I would like to mention in passing, however, that we had a very substantial continental defense program before the events of the late summer. Moreover, this was backed up by a very substantial research and development program that frankly recognized the technical deficiencies in the way of achieving an airtight defense. Any concept that the country was caught napping is wholly unfounded. We must recognize, however, that the technological race we are in has some of the aspects of a chess game in which each player makes his moves and countermoves to dispose his forces to maximum advantage. There is no end to such moves, no ultimate answer. In a

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the **GIANT** *that makes* **MIDGETS**

Ability to think big about miniaturization problems is only one of the many talents that has set Raytheon apart in the field of electronics. It is an example of how Raytheon is serving the current needs of the Armed Services while paving the way for new and better developments.

Not all Raytheon products are small but all benefit from Raytheon's broad experience with miniaturization. Raytheon pioneered in the development of reliable miniature vacuum tubes, now leads in the production of subminiature tubes, germanium diodes and transistors. Miniature magnetic components are another example of Raytheon's unique ability to pack perfection into incredibly small units.

Raytheon has also pioneered in the application of miniaturization techniques to complete equipments. The benefits are unmistakably reflected in the compact design, trim appearance and servicing ease of *all* Raytheon products which include radar, sonar, communications equipment and other types of electronic equipment used in all branches of the Armed Services.

RAYTHEON

Excellence in Electronics

RAYTHEON MANUFACTURING CO.

CONTRACTORS TO THE ARMED SERVICES

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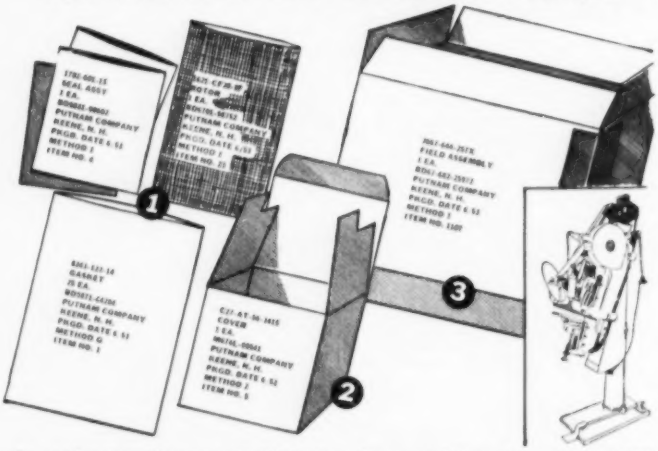
MARKEM SOLVED THIS MARKING PROBLEM

IDENTIFICATION MARKING
FOR CONTRACT AND OVERSEAS PACKING



In contract and export packing of parts, assemblies, etc., certain JAN specifications call for three packaging stages: (1) enclosure in scrimback or polyethylene lined *heat sealing* envelope, (2) intermediate packing in a folding box, (3) final packing in corrugated carton. Each of these three types of containers must be marked for instant and *permanent* identification. Many manufacturers, dissatisfied with conventional marking with crayon, stencil, labeling or other form of hand stamping, have not only found great savings in time and money, but also obtained more legible, longer lasting identification using a Markem Method. *One* Markem machine (with appropriate Markem type and Markem ink) prints desired information on *all three* containers. The vapor barrier of the envelope is not broken. Desired information is changed rapidly. By printing quantities of containers as and when needed, inventory problems are minimized. In this way, the Markem Method insures *positive identification* when the items reach their destination.

MARKEM® MARKS THEM ALL

CAN MARKEM HELP YOU? Identification printing for contract and overseas packaging is but an example of how Markem solves industry's marking problems. Markem has been providing industry with production techniques and equipment to identify, decorate or designate its products, parts and packages since 1911. Markem also provides technically trained men who are available in your area to assure *continued* satisfaction with Markem methods and equipment.

When *you* have a marking problem, tell us about it and send a sample of the item to be marked. Perhaps a complete Markem Method has already been developed to solve your problem. If not, Markem will work out a practical solution.

Markem Machine Company, Keene 9, N. H., U. S. A.

MARKEM ...TO MAKE YOUR MARK

From the Record

technical sense there is always a countermove for each move, although it may be difficult and costly.

There are two handicaps placed on us in this race. The first is that our abhorrence of the aggressor rôle allows our adversary to choose at any time whether it will be, to change my similes a bit, a 100-yard dash or a marathon. The second grows out of our public information policy that hands our adversary a mass of information about our plans and arrangements without any corresponding coöperation on his part.

While these are very substantial initial handicaps, they are in final analysis not handicaps at all. Sticking to the nonaggressor rôle is an essential element of our position in the court of world opinion. And keeping the public informed is essential—at least some of it is essential—to that common understanding that is fundamental to unity of purpose at home.

ALL of this is just part of our faith in our decent, honest, free-enterprise, democratic system. It is nothing new that the better system should have to enter the race with a few handicaps. One might almost say paradoxically that the handicaps assure the victory.

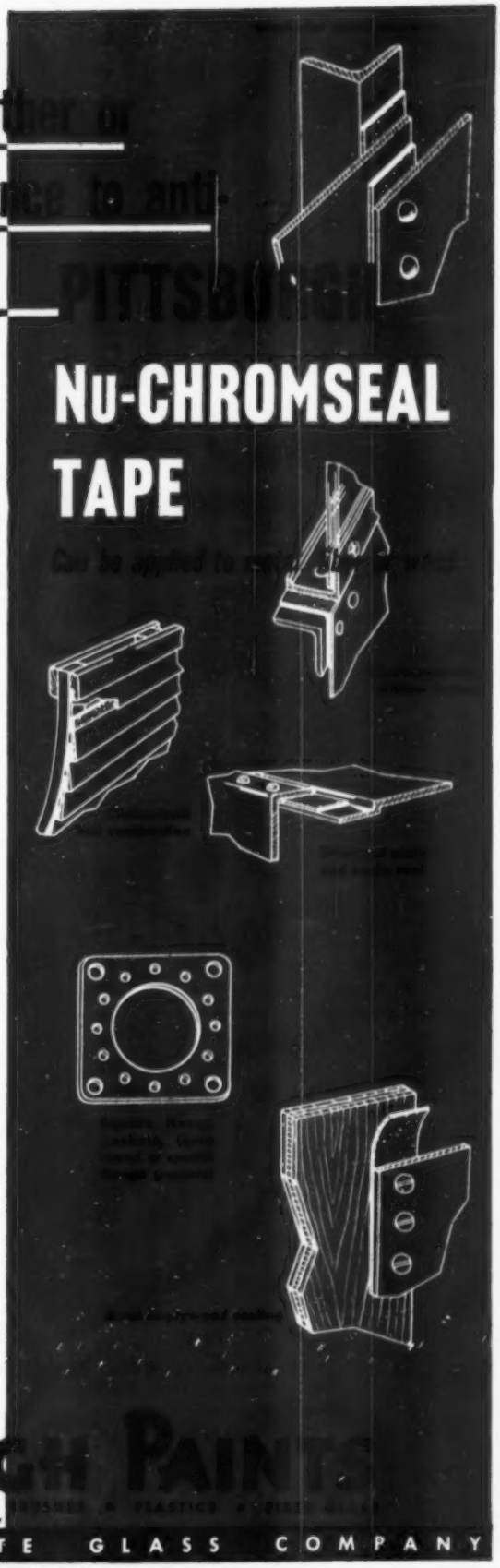
Under these circumstances, some things stand out clearly. First, we must make the 100-yard choice, the quick showdown, a very unattractive choice, and I believe our powerful Strategic Air Command, backed up as it is by a potent atomic weapons program, is a most important and a most discouraging influence in this regard. Secondly, we must bend every reasonable effort toward a tight continental defense.

I say "reasonable" because I believe it would be unreasonable to sink large sums into obsolescent arrangements when much superior ones are in the offing. We must leave these judgments to those who can judge the issues in their technical and logistic detail. We must recognize, too, that the race may very well be a marathon which requires us to husband our resources for the long pull.

These are concepts that are not easily gotten across to the public. . .

I can assure you that those responsible for calling the shots in Washington take their responsibility most seriously and welcome any advice and help that you can give them. The goal, of course, is peace, but the road to it is a tough competition. I believe that a strong aggressive research and development program is a key to our competitive position.—DONALD A. QUARLES, *Assistant Secretary of Defense for Research and Development, before the Stanford Research Institute, San Francisco, Calif.*

For better insulation . . . weather or waterproofing . . . and resistance to anti-galvanic corrosion . . . . . use



MORE AND MORE production executives in many industries are turning to Pittsburgh's Nu-Chromseal Tape to seal lap joints or butt seams in metal, wood or fiber, where rivets, bolts or screws are used.

● **Nu-Chromseal Tape** is a solid, pliable compound of fixed width and thickness of unusual versatility. It can be used for weatherproofing of roof and side panels of motor buses; for caulking around fender-to-body seams of motor cars; in various seams of marine craft, for sealing water, gasoline and oil storage tanks; and as a galvanic insulator between dissimilar metals to prevent corrosion. It is also an excellent anti-squeak or anti-chafe medium between wood or metal members which have a tendency to rub.

● **Nu-Chromseal** is gently adhesive so that it can be readily applied under rapid production conditions. It can be used on units where baking temperature runs as high as 375 degrees, without bleeding or materially changing in character. Its pliable consistency permits easy tailoring—excess material can be readily trimmed.

Pittsburgh also offers WELDSEAL and FABSEAL Tapes

● **Weldseal** Tape protects spot-welded and hot-riveted assemblies from corrosion by sealing seams against moisture.

● **Fabseal** Tape is an impregnated fabric that forms a complete seal between wood, metal or fiber members.

Samples of these remarkable tapes are available on request for experimental work. Our engineers will be glad to consult with you without charge or obligation.

PITTSBURGH PLATE GLASS COMPANY—Industrial Paint Division; Pittsburgh, Pa. Factories: Milwaukee, Wis.; Newark, N. J.; Springdale, Pa.; Atlanta, Ga.; Houston, Texas; Los Angeles, Calif.; Portland, Ore. Ditzler Color Division, Detroit, Michigan. The Thresher Paint & Varnish Co., Dayton, Ohio. Forbes Finishes Division, Cleveland, Ohio. M. B. Suydam Division, Pittsburgh, Pa.

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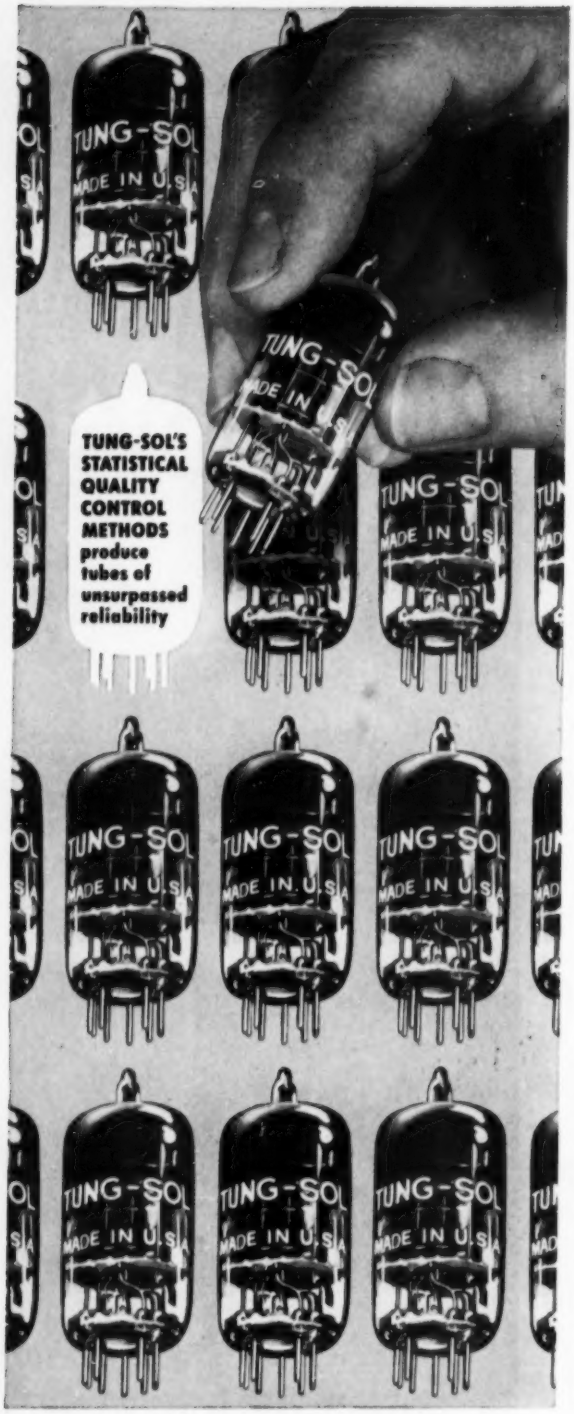

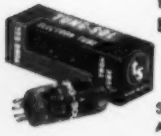

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Report on the Atom. By Gordon Dean. New York: Alfred A. Knopf, Inc. 321 pp. $5.

ORDNANCE and industry are finding the fields of electronics and atomic energy ever expanding. The electronics industry (based on atomic physics research) has developed to such an extent that those of us who are not expert in electronics feel somewhat lost when forced to deal with problems pertaining to electronics design, manufacture, supply, and maintenance.

The potentialities of atomic energy (also based on atomic physics research) are probably even less known. Mr. Dean's book provides a glimpse of how the future may be revolutionized by applications of atomic energy to peaceful purposes.

The book contains a nontechnical history of atomic-energy developments during the last decade. As chairman of the Atomic Energy Commission from 1950 to 1953, Mr. Dean dealt with every important phase of atomic-energy activities. He describes them and brings us up to date on current unsolved major problems of the Commission. He believes that the solution to these problems, when obtained, will have major effects on all countries.

Mr. Dean has provided readable accounts of AEC activities pertaining to uranium ore, production of fissionable materials, atomic weapons, the law under which the Atomic Energy Commission operates, AEC relationship to the military, development

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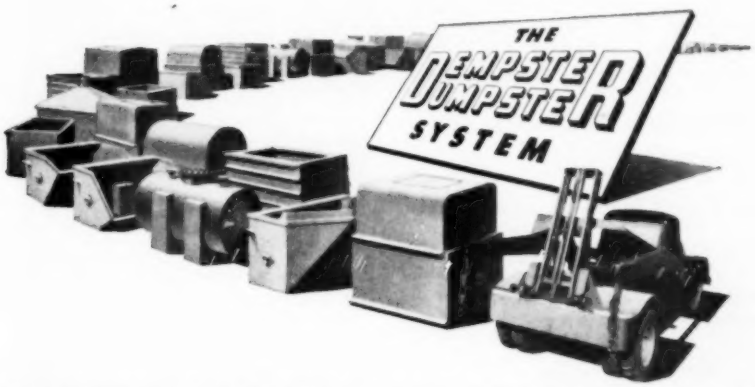

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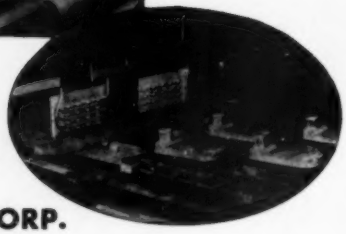

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Book Reviews

and production of industrial power sources from atomic energy, atomic energy used for driving airplanes, submarines, and surface ships, and radioisotopes used in medicine, agriculture, and industry.

This book is recommended as reliable and authoritative reading material for those in industry and Ordnance who are interested in equipment development trends and as quick reference material for those whose current activities may touch on atomic energy.—PHILIP SCHWARTZ.

From Down Under to Nippon. The Story of the Sixth Army in World War II. By Gen. Walter Krueger. Washington: Combat Forces Press. 393 pp. $6.50.

THE publishers say that "this book is General Krueger's testimonial to his troops." It is all that and more. Almost unconsciously it also gives a character study of General MacArthur in which one sees that his famous wading ashore with the troops at Leyte was not mere showmanship but rather the General's everyday method of personal attention to important detail.

Even in the personal selection of General Krueger for the command, it is evident that MacArthur realized what he had to face and knew the kind of man he wanted to carry out the strategy.

This book is likely to be more useful to historians of the future than even the elaborately documented official histories that eventually follow every war. It shows to the world that the United States, while supposedly fully occupied fighting major full-scale wars in Europe, Africa, and the North Pacific could still carry to a successful conclusion, without one important setback, another large-scale war over an immense area at an extreme distance from home.

Its study will certainly indicate to future historians the real reason why the MacArthur methods later kept the Soviet out of Japan and why the General never deviated from the belief that a firmness on the part of America would have prevented the encroachments of the Communists elsewhere.

Throughout the South Pacific islands virgin jungles made advances difficult. Roads and docks had to be built as fast as advances were made. Without priorities, small ships for interisland transport were lacking. Trucks and construction equipment were scarce and had to be picked up and transported by LST's with each new assault.

Adequate service troops were lacking, and the manner in which the assorted host of men from gas-station attendants to lawyers adapted themselves to the solving

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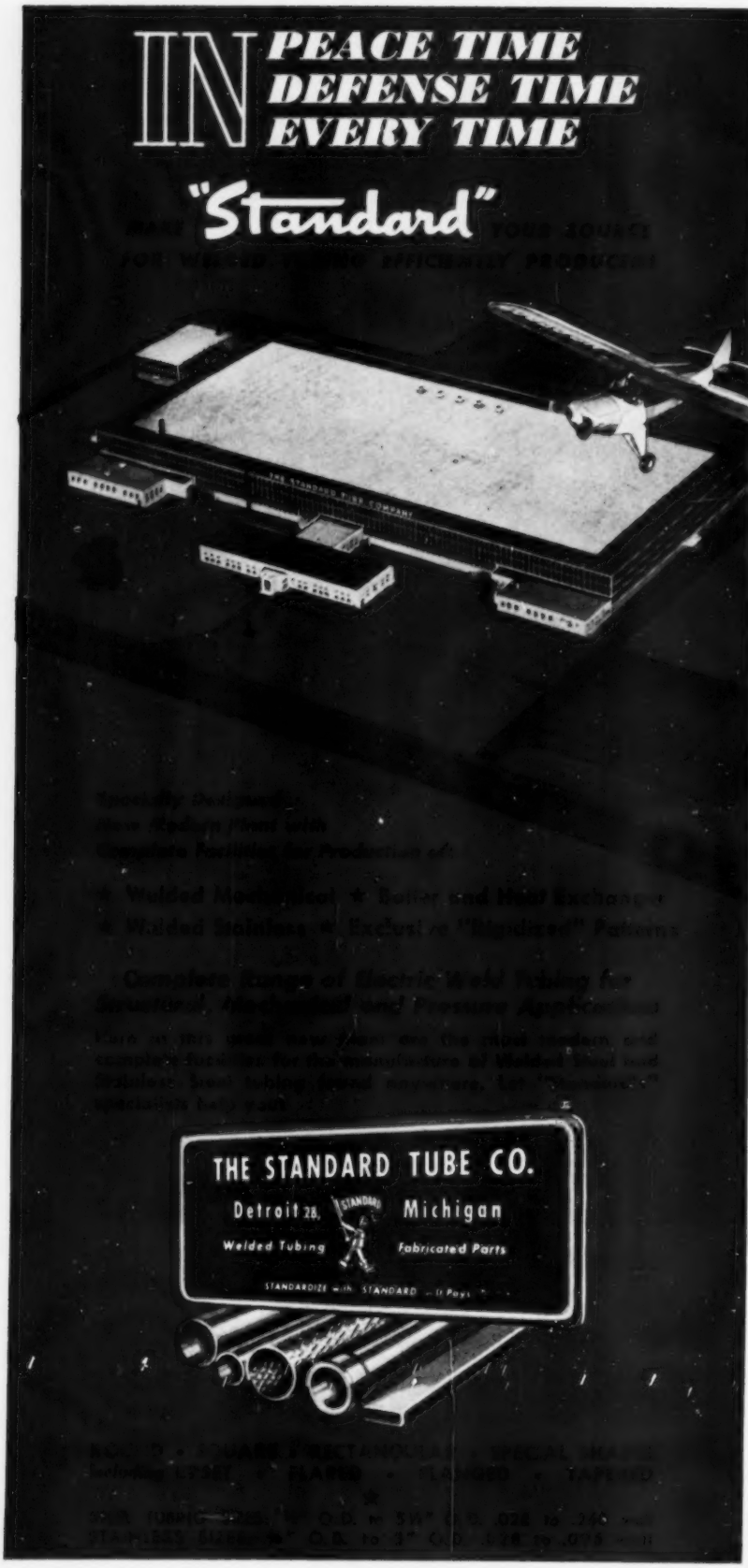

of technical problems is an American epic. To complicate matters, supply officers in the United States appeared to have no conception of the great distances, and shipments were often split and loaded into different ships going to points far apart.

Unprecedented freedom was often given to field commanders to alter the plans made at the distant command base when advisable to meet local conditions, and the General never hesitated in scrapping original plans when it was shown to him that short cuts could be made.

More than once the Japs were thus deceived by encircling movements that short-cut the normal path. Japanese commanders later stated that they had had long delays in arranging joint movements of their own ground, air, and sea forces, and that they were astonished and frustrated by the unbelievably rapid coördination of the American forces.

Reading this book one wonders why the America that could drive the South Pacific operation through with its toe while its hands were engaged elsewhere need now cringe and compromise in dealing with a slave-labor autocracy. Read this book and thrill at being an American!—GEORGE S. BRADY.

Stilwell's Mission to China. By Charles F. Romanus and Riley Sunderland. Washington, D. C.: U. S. Government Printing Office. 441 pp. $5.

SOON after Pearl Harbor some diplomatic incidents and our own early military reversals caused fear in Washington that China might make a separate peace. This would have released for action elsewhere in the Pacific area ten or twelve good Japanese divisions then immobilized in China by the inactive Chinese forces. As the release of such forces might have entailed serious consequences for the United States, President Roosevelt decided, at the request of the Chinese, to send a high-ranking U. S. officer to take charge of our affairs and keep China in the war.

That officer was Lieut. Gen. Joseph W. Stilwell, an "old China hand" who knew the Chinese very well from his previous experience as military attaché in China during the critical years of Chiang Kai-shek's rise to power.

Thus began Stilwell's "Mission to China." His orders were to increase the combat effectiveness of the Chinese Army and to hasten U. S. Lend-Lease aid. Four hats were issued to him: (a) Joint Chief of Staff to Supreme Commander, China Theater (Chiang Kai-shek), (b) commanding general of a U. S. Task Force, (c) U. S. representative of an Allied military council, and (d) the President's representative for Lend-Lease.

How he was able to carry out all these

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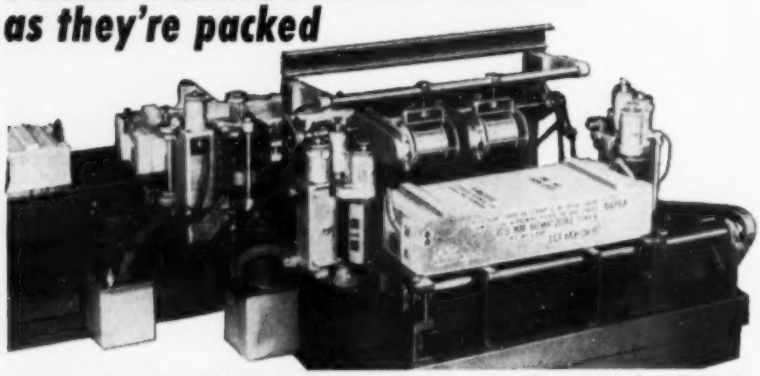

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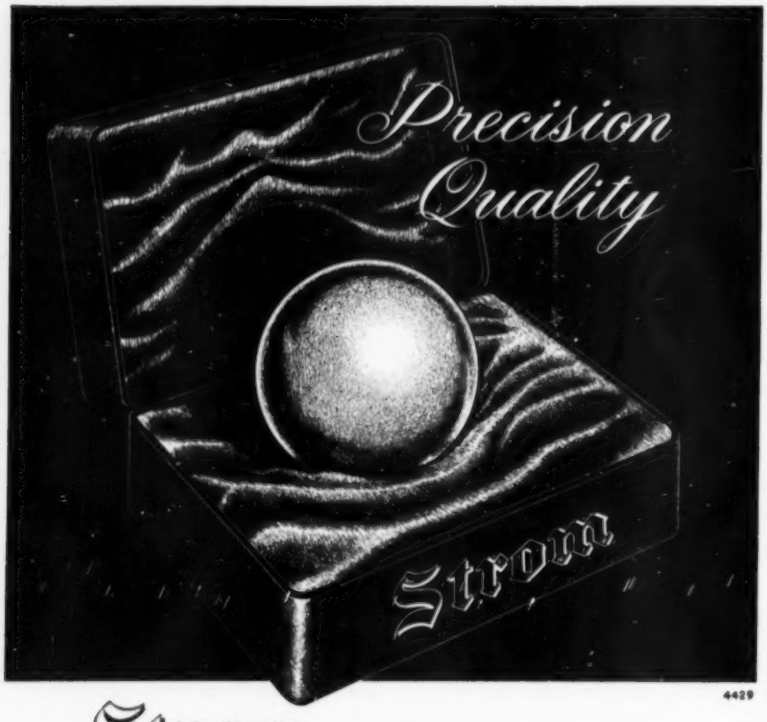

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assignments, his successes and failures, are described in this first volume of the official history of the U. S. Army in World War II dealing with the China-Burma-India Theater. The authors are trained historians who have produced a readable and at times dramatic account of events in a little-known area of our participation.

Their documentation indicates meticulous research, and appropriate maps go with the volume. The bibliography indicates that they had complete access to the sources, including the private papers of General Stilwell and other participants.

Quite to his surprise, your reviewer learned that his own diary as a participant seemed to have some value as a source for the early period of Stilwell's mission.

From the beginning, Stilwell had many troubles flowing out of divided counsels at home and demands within China and in Washington for air-power development at the expense of effective Chinese ground forces. He fought continously to improve the efficiency of the Chinese ground forces.

He did not achieve his full objectives, but those of us who were with him felt that he accomplished much for the Chinese armies.

Finally, in October 1943, he decided that he was at the end of his resources in so far as this mission was concerned. "What more can I do?" he noted in his diary as he prepared to take up new duties in the recently formed Southeast Asia Command. The days of the Stilwell Mission were at an end.

It is to be hoped that the same authors will undertake the remaining volumes of the C.B.I. series. They will have an interesting story to tell of the post-Stilwell period.—E. E. MacMorland, *president, Pennsylvania Military College, Chester, Pa.*

Russian Assignment. By Vice Adm. Leslie C. Stevens, U.S.N., Ret. Boston: Atlantic-Little, Brown. 568 pp. $5.75.

ADMIRAL Stevens kept a personal diary of his experiences and impressions over a very critical period in the Western World's relations with Soviet Russia. During that period, 1947-1949, the author was our naval attaché in Moscow, and his diary is the basis for this book.

His prior knowledge of the Russian language, both written and spoken, and his constant effort to improve himself in that field fulfilled a basic requirement in the make-up of one who would understand the Russian and Russia.

His book is, in a sense, a travel book. His extensive coverage of all permissible places, together with his keen sense of

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BOOK SERVICE

Book of the Month for January

THE STORY OF THE U. S. CAVALRY, 1775-1942

By Maj. Gen. John K. Herr, U.S.A., and Edward S. Wallace

This is a story rather than a detailed history of the United States Cavalry written by the Army's last Chief of Cavalry, General Herr, and his coauthor, a professional historian. A great many distortions concerning cavalry participation in American wars from the Revolution on are corrected and the vital rôle of American cavalry in protecting the westward expansion of the Nation is a fascinating tale. The foreword by the late Gen. Jonathan Wainwright makes an appeal for reactivation of cavalry units that is both interesting and thought-provoking. Retail, $6.00. To Members, $5.40.

UNCONDITIONAL HATRED

By Capt. Russell Grenfell, R.N.

An analysis of one of the by-products of unlimited war—the fallacy of the demand for unconditional surrender. Captain Grenfell, a British Naval officer, in plain and blunt language presents the case for those who opposed unconditional surrender and cites the terrific cost of trying to conclude peace—as yet still unconcluded after eight long years. Retail, $3.75. To Members, $3.37.

The Journals of Lewis and Clark

Edited by Bernard DeVoto

Significant history—a fascinating and factual account of the nineteen months of exploration which had to do with the Louisiana Purchase and the beginnings of the American Northwest, written in the summarized words of the famous explorers. Retail, $6.50. To Members, $5.85.

UNDERSEA PATROL

By Edward Young

The record of a British submarine in World War II. Never-ending tension of perilous action in the North Atlantic, the Mediterranean, and the Indian Ocean. Retail, $3.95. To Members, $3.55.

HITLER'S DEFEAT IN RUSSIA

By Lieut. Gen. W. Anders

The famous Polish commander assesses the Soviet victory. He successfully combats the propaganda that "Russia did it alone," and he evaluates the current war potential of the U.S.S.R. Retail, $4.00. To Members, $3.60.

RUSSIAN ASSIGNMENT

By Vice Adm. L. C. Stevens

This personal record of two crowded years in Russia, rich in s und perceptiveness, conveys a wealth of information on the people of that land. Retail, $5.75. To Members, $5.17.

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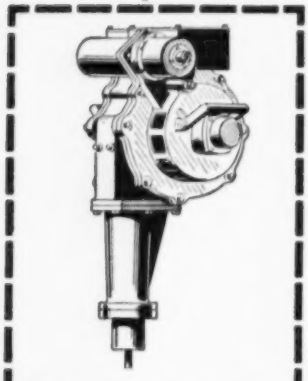

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observation, followed by his ability as an author to translate his experiences into interesting narrative, makes this the most interesting and easily read book on Russia and its people that I have perused.

After reading this book one feels that he knows the Russian people, but that knowledge gives little hope that they will quickly change to any other form of living. Their suspicions and fears and studied disinterestedness are not encouraging to those who hope for a facing toward the West.—T. K. VINCENT.

Conquest of the Moon. By Dr. Wernher von Braun, Dr. Fred L. Whipple, and Willy Ley. New York: The Viking Press. 126 pp. $4.50.

"CONQUEST of the Moon" will probably stimulate more technical discussion among nontechnical people than any book since Jules Verne's "Twenty Thousand Leagues under the Sea."

This book, with its masterful illustrations, is indeed convincing. It is fascinating reading, even to those who disagree. The authors make a plausible argument that it is highly desirable to explore the moon and that it can be done twenty-five years from now with the expected extension of the current state of the art.

The details of the mathematical analysis of the problem, the preparation and execution of the flight, and the exploration and return are stimulating and exciting. To those of us greatly preoccupied with costs and budgets, it appears that this aspect is brushed over lightly.

Whether or not we can or do explore the moon in twenty-five years is in no sense as important as the great interest in exploring the remaining frontiers—the frontier of science and the frontier of interstellar space.—EDWARD P. MECHLING.

Hitler's Defeat in Russia. Lieut. Gen. W. Anders. Chicago: Henry Regnery Company. 267 pp. $4.

TO both professional soldiers and historians the causes of the German defeat in Eastern Europe between 1941 and 1945 undoubtedly will be the subject of much intensive research and review for years to come.

Source material covering this period is extremely one-sided. Obviously, the German data are rather complete and readily available. However, for the Russian version, there is a dearth of information, and the published data have a propaganda tinge, so that their use necessitates careful and critical sifting.

It is this studious and objective analysis that is presented by General Anders, who is eminently qualified to review and delve into the analysis of operation "Barbarossa"—Hitler's onslaught on Russia.

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Book Reviews

Having fought on the side of Czarist Russia in World War I and having fought against Soviet Russia and Nazi Germany in World War II, both in Poland and in Italy, General Anders is uniquely suited to render a sound appraisal of this campaign and to analyze the strength and weakness of the present and the future Soviet regime.—S. M. SMOLENSKY.

The Raid: A Biography of Harpers Ferry. By Laurence Greene. New York: Henry Holt & Company. 246 pp. $3.

"BIOGRAPHY" may seem a strange term to apply to a place rather than a person; but the author, a veteran free-lance writer, moved to Harpers Ferry, became one with its people, and shows that a small and remote town develops a personality not unlike a man—or at least—a family.

The book makes no pretense of being a documented history or record of the event which gave the volume its primary title. Rather the two-thirds of the book which is devoted to the story of Brown's grandiose attempt to hasten the course of history recounts it as seen from the lives of those folk who spent days of terror, and excitement during its outbreak and suppression.

Greene writes with a pen that is both pithy and pungent, yet without flamboyance. The result is an objective story of the "raid," treated as a vignette in that larger picture of national tragedy which, possibly was made finally inevitable by those hectic doings in the sleepy village where the rivers meet.

While perhaps not a volume of significance, this reviewer guarantees that few readers will be able to put it aside till the last word is finished.—F. W. FOSTER GLEASON.

The Pistol Shooter's Book. By Lieut. Col. Charles Askins. Harrisburg: The Stackpole Company. 347 pp. $6.

COLONEL Askins has written an outstanding book for the pistol shooter, but any one who shoots for any purpose should enjoy this volume—pistol shooters, of course, most of all.

Running contrary to the too-often stuffy practice of pouring out paragraphs of patter on technical matters, Colonel Askins has put plenty of mustard into this manuscript on marksmanship. His fascinating stories about the U.S. Border Patrol make the saga of Billy the Kid and Wild Bill Hickok seem mild by comparison. To steal Colonel Askins' favorite adjective, this reviewer thinks the book is a "duzy."

Overnight experts with the hand weapon should particularly read the colonel's comments about safe handling of pistols, and those who feel they simply must have a foreign pistol should first read and reread Chapter 6.

The author has included some excellent chapters by other authors in this modern encyclopedia. Among those of particular interest to this reviewer was Chapter 12 on "Buck Fever" and Chapter 14 containing a medical discussion on "Eyesight."

This is one of the distinctly better gun books and will be widely received.—MELVIN M. JOHNSON, JR.

Automotive Mechanics. By Joseph Heitner. New York: D. Van Nostrand Company. 501 pp. $6.

MR. Heitner has accomplished with this text that which few authors have been successful in doing—he has produced a complete basic text on the automotive vehicle in a single volume.

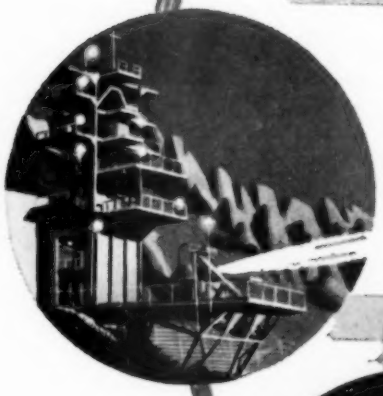
The build-up from the basic principles involved to the present complicated mechanisms is especially well done, although in some instances additional illustrations and diagrams would facilitate better understanding. However, the subject matter is clearly and logically presented and progresses from the basic principles, construction, and operation to the maintenance and repair of the major components of the modern automobile.

This is a basic text with the stress on the "how" rather than the "why" and should be a welcome addition to those available at vocational or trade-school level.—JOHN D. BILLINGSLEY.

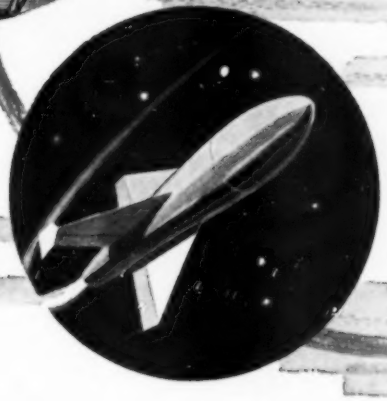
Formula for leadership in the GUIDED MISSILE FIELD

O + F + E

ORGANIZATION—Today North American Aviation's guided missile program is manned by more than 4800 highly skilled and imaginative scientists, engineers and craftsmen . . . many of them leaders in their particular fields . . . integrated into one of America's foremost organizations in guided missile development.



FACILITIES—Often invented to fit a specific need . . . North American's great array of technical equipment used in guided missile projects staggers the imagination. A great part of this equipment at North American's testing grounds and research facilities at Santa Susana and Downey, California is completely new and unique in American industry.



EXPERIENCE—North American began pioneering research in the guided missile field before V-J Day. The knowledge provided by North American's advanced work in miniaturization, rocket engines, rockets, ballistics, fuels, automatic navigation and flight mechanisms . . . and in actual test firings . . . is helping to speed America's progress in all phases of guided missile and rocket development.

NORTH AMERICAN AVIATION, INC.

TWENTY-FIVE YEARS OF BEING AHEAD OF UP-TO-DATE

For the "FIRST LINE OF DEFENSE"

*U. S. ARMY PHOTO

Shell Nosing Press

Shell Piercing Press

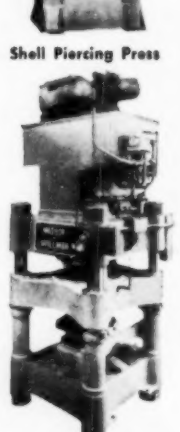
You Get MORE Ordnance for LESS with *WATSON-STILLMAN* Presses

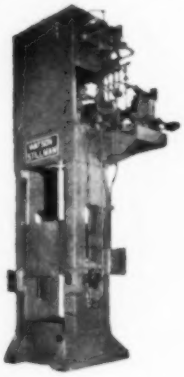
Because its product is expendable and vital, too, ordnance manufacture calls for the greatest possible economies commensurate with sound production practice. With W-S ordnance presses on the job, you get this economy two ways:

INCREASED PRODUCTION: Because they are special purpose machines, thoroughly proved in years of production operation, W-S presses cut valuable minutes and money from your unit production cost . . . increase overall efficiency and reduce maintenance.

FEWER REJECTS: the smooth, dependable, uniform power of hydraulic operation cuts salvage to the bone . . . conserves critical materials and releases man-power for more productive work.

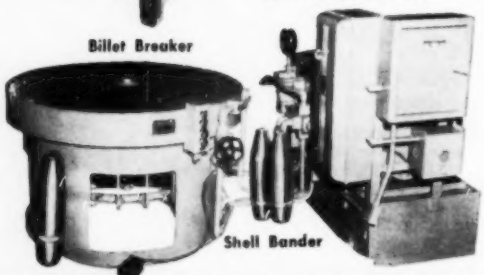
Write for complete details of W-S Ordnance Presses, or arrange for our representative to call.





Cold Extrusion Press

Billet Breaker



Shell Bander

W-S HYDRAULIC

ESTABLISHED 1848

THE WATSON-STILLMAN COMPANY

DIVISION OF H. K. PORTER COMPANY, INC.

164 ALDENE RD., ROSELLE, NEW JERSEY

9-0-48

W-S Shell-Line Hydraulic Presses for Shell Billet-Breaking, Piercing, Drawing, Nosing, Banding, Crimping, Loading.

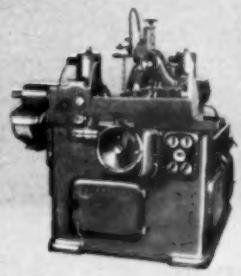
SHEFFIELD MACHINE TOOLS

guard *PRECISION* in the shop

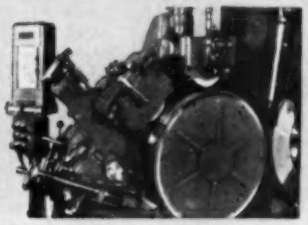
Micro-form Grinder, Model 121 grinds high precision profiles both flat and circular directly from large scale drawing, saving up to 75% over conventional practice. ☐

Micro-form Grinder, Model 122 equipped with a combination 30 power microscope and viewing screen. ☐

Thread and Form Grinder, Model 133 uses the multi-ribbed wheel principle to grind small precision threads and intricate forms on a high production basis. ☐

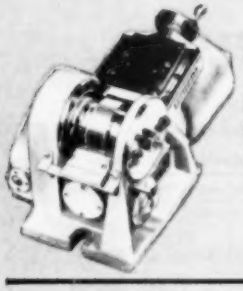


Precision Thread and Form Grinders —100 Series, produce precision threaded elements and cylindrical forms by the Crushtrue method, the diamond dressed multi-ribbed wheel or the single point wheel method. ☐



Special machine tools are a Sheffield specialty, such as this one of 12 jet turbine shroud grinders placed in operation within the last six months. ☐

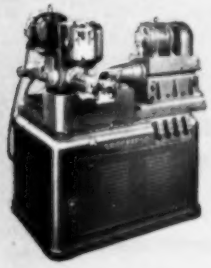
Idler and motorized type Crushtrue devices are available for forming grinding wheels on standard surface grinders. ☐



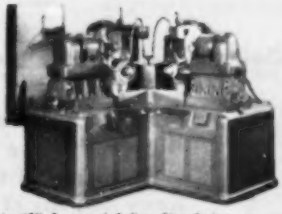
Self-truing Motorized Crushtrue Device forms surface grinder wheels for the grinding of flat form tools, etc. of the highest precision and uniformity. ☐

The Sheffield Crushtrue Roll Bank plan provides Rolls for production use while worn rolls are enroute to Sheffield for re-grinding and re-ground rolls are enroute from Sheffield for use. Nominal exchange charge. ☐

Gear and Spline De-burizers deburr or chamfer up to 600 gear teeth per minute. Applicable to spur, helical, hypoid, bevel and herringbone gears —also multi-start worms. ☐



Gear and Spline Chamfering Machines chamfer, burr or recess the ends of gear teeth at high production rates—ideal for short runs and quick changeover. ☐



Style "C" Gear and Spline Chamfering machines have two cutter spindles and two workheads for mass production gear manufacture. ☐

Sheffield is prepared to produce precision threaded elements and formed parts on contract to augment your own manufacturing facilities. ☐

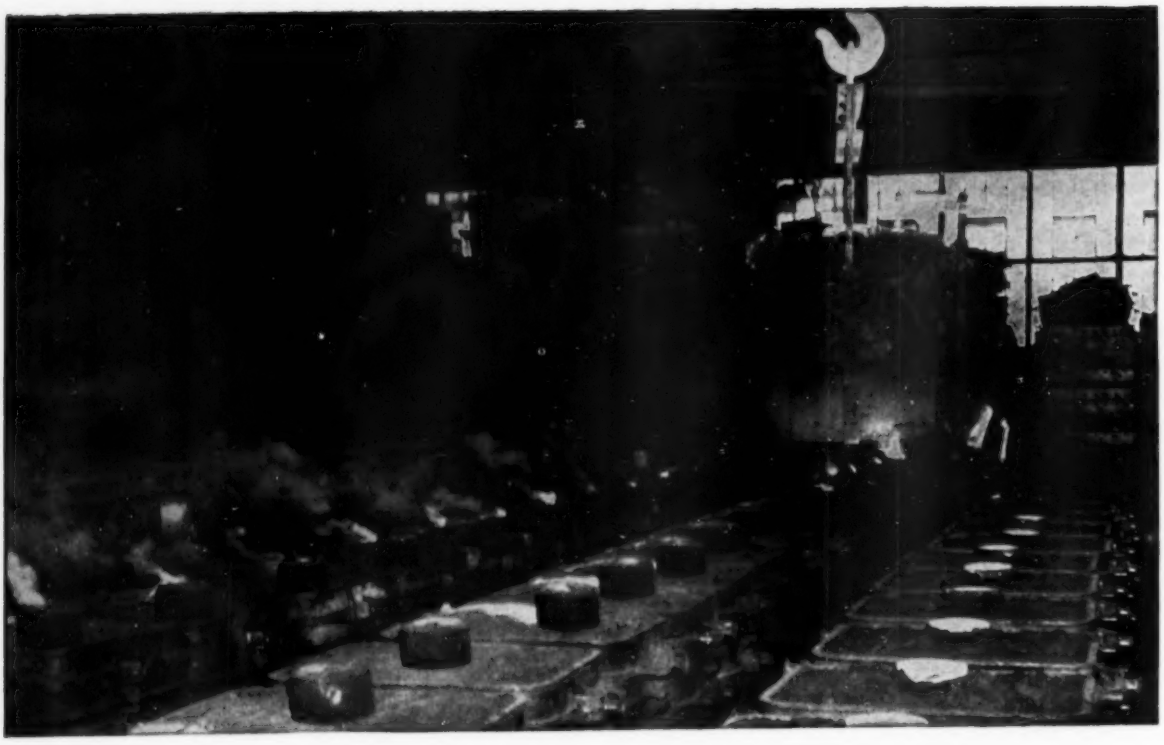
CHECK THE BOX ☑ for any piece of equipment or service in which you are interested. Tear this out, attach it to your letterhead, mail to Sheffield, and detailed engineering data will be forwarded.

Machine Tool Division • The Sheffield Corporation
Dayton 1, Ohio, U. S. A.

MASTER CRAFTSMAN SHEFFIELD HEADQUARTERS

SHEFFIELD

6559



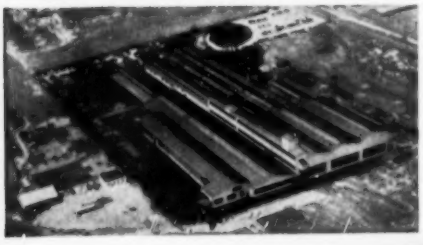
ASK THESE MEN OF RIVERSIDE TO HELP SOLVE YOUR

STEEL OR GRAY CASTING PROBLEMS

Riverside Foundry is ready to give you excellent service on cast armor and all types of QQS 681-B materials. **In fact, any steel casting specifications for which your contract might call.** We have a full staff of men who have spent years producing ordnance material.

Our customers include many great names of American Industry: Chrysler, American Locomotive, International Harvester, Fisher Body and Ford Motor Company. **Ask them about Riverside.**

Call or write us at Riverside today.



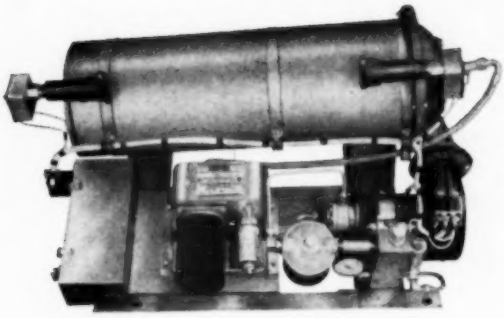
The big modern Riverside Foundry at Bettendorf, Iowa has the best equipment to do the best job.

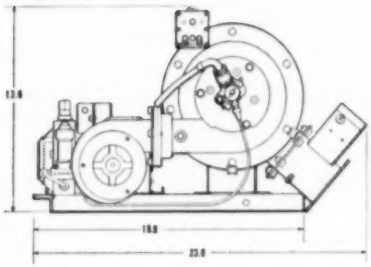
For a dependable qualified source of steel casting requirements, see Riverside. You give us your drawings. The rest of the job is ours. Save yourself time, worry and loss of production. We are ready to do a complete job for you on any casting requirement.

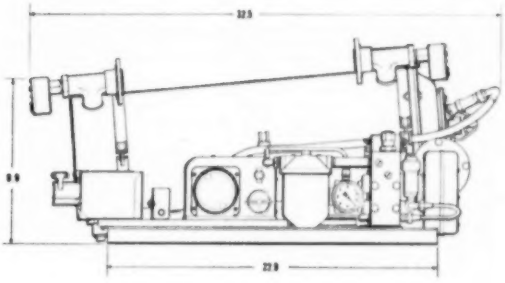
it takes a

JANITROL SIMPLIFIED LIQUID HEATER

to give all of these:







dependability

Thousands of military vehicles have proved that Janitrols *do* the job. "U.R.s" are virtually non-existent—proof of field dependability. "One shot" acceptance on installation qualification tests . . . Janitrol liquid heaters passed every one the first time . . . further proof of Janitrol manufacturing dependability.

adaptability

Design for present or projected vehicles is simplified. Closed system of 1" tubing is easier to install, affords greater flexibility, saves space. Heater uses vehicle fuel—gasoline, diesel or jet fuel. Applications include fuel preheating, cab, cargo and engine pre-heating, defrosting, and maintenance of correct diesel engine operating temperature.

efficiency

Extra heat transfer area, coolant container walls exposed to radiant and convected heat. Sealed in whirling flame combustion chamber plus counter-flow coolant travel result in top heat transfer efficiency.

economy

"Demand" operation (fully automatic cycling) conserves fuel, means longer heater life. 90,000 Btu/hr output, maximum (continuous full capacity operation) fuel consumption less than one gal/hr.

maintenance ease

Interchangeable "plug-in" components speed inspection and servicing. All units, except combustion chamber, accessible for servicing without removing heater.

PLUS SERVICE & SAFETY PROVEN WORLD-WIDE

Janitrol *Liquid* Heater service is proved, not just in a laboratory, but on thousands of military and commercial vehicles *in the field*, all over the world.

Janitrol Liquid Heaters exceed all trade and military specifications for safety! Automatic blower overrun purges heater after each shutdown. Dual contact, fully radio shielded, high tension ignition system is completely hazard free, unaffected by extremes of weather or altitude.

Janitrol's wealth of vehicle heating knowledge, the culmination of over 36 years combustion engineering experience, is at your command through our nearby field representative.

Condensed Specifications

operation	diesel oil, gasoline, or jet fuel
weight	80 lbs
output rating	90,000 Btu/hr
fuel input (continuous operation)	less than 1 gal/hr at rated output
fuel pressure	30–32 psi
power requirement	5–6½ amp at 24 volt dc
stack temperature rise	650 to 750° F
coolant circulation (calculations 30° F rise)	Water–5 gal/min Ethylene Glycol (60/40)–9.6 gal/min

HEAT WHEREVER YOU WANT IT

Janitrol

AIRCRAFT-AUTOMOTIVE DIVISION SURFACE COMBUSTION CORP., TOLEDO 1, OHIO

National Sales, Engineering, Production Headquarters, 400 Dublin Ave., Columbus 16, Ohio. District Engineering Offices: New York, 225 Broadway; Washington, D. C., 4650 East-West Highway; Kansas City, 2201 Grand Ave.; Ft. Worth, 2509 West Berry St.; Hollywood, Calif., 7046 Hollywood Blvd.; Columbus, Ohio, 400 Dublin Ave. Executive Offices: 2375 Dorr St., Toledo 1, Ohio.

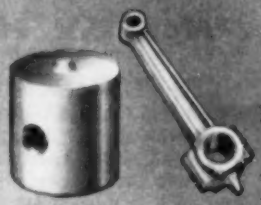
These are parts of the casing for a new underwater guided missile, sand cast in the foundries of Aluminum Industries, Inc.

This big sand casting is a part for bakery equipment that will eventually find its way into a GI kitchen.

Aluminum sand casting, light-weight yet strong, is ideal for this Supercharger housing. This is for a conventional propeller aircraft.

This main housing is one of seven parts of a fuel pump sand cast by Aluminum Industries, Inc. for aircraft application.

Washing machine agitators, cast by the permanent mold process, are a peacetime product of the Aluminum Industries, Inc. foundries.



Pistons of all types are cast by Aluminum Industries, Inc. This small piston and the connecting rod are permanent mold castings for small utility engines.

Compressor casing for jet aircraft engine. Exceptionally large permanent mold castings, weight 130 lbs. each. Aluminum Industries, Inc. casts numerous parts for the J-47.

weapons... washers... and wheels

A little part of the big story of

Aluminum Castings

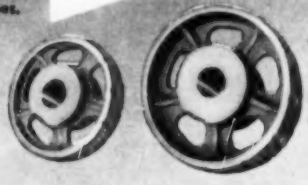
produced in

ALUMINUM INDUSTRIES

Foundries

● Manufacturers in many different lines of civilian and defense production often are able to speed output or reduce costs, or both, by changing to lightweight aluminum castings by Aluminum Industries, Inc. Our engineers will gladly consult with you and make recommendations on your parts requirements.

ALUMINUM INDUSTRIES, Inc.
CINCINNATI 25, OHIO
New York: 9 Rockefeller Plaza
Detroit: 809 New Center Bldg.
Chicago: 64 E. Jackson Blvd.



The diversity of castings produced in Aluminum Industries, Inc. foundries is endless. These aluminum sand castings are caster wheels for industrial trucks.

PERMITE **Aluminum Castings**

ALUMINUM PERMANENT MOLD and SAND CASTINGS... HARDENED, GROUND and FORGED STEEL PARTS

A NEW TERMINATION TECHNIQUE FOR . . .

- COMPUTERS
- SWITCHBOARDS AND INSIDE PLANT EQUIPMENT
- RELAYS, SWITCHES, AND MULTI-CIRCUIT COMPONENTS

AMP

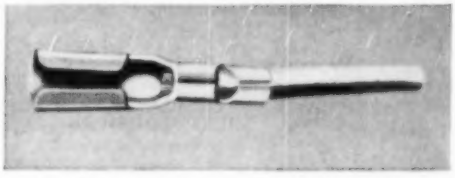
FLAT TAPER TAB RECEPTACLES

If you are concerned with the wiring of close spaced equipment, investigate the new AMP Solderless TAPER TAB RECEPTACLE for flat relay or switch tabs shown at right. It is self locking when installed on a male tab with matching 3½° taper, yet can be removed and reconnected any number of times without solder or special tools. These terminals are supplied on reels in continuous strip. Customer crimps them on wires using AMP automatic machines at speeds up to 4,000 per hour!

Performance of these miniature connectors meets exacting requirements for millivolt drop, corrosion resistance, and vibration. They are suited for critical low level circuits or power circuits up to several amperes.

Write to AMP Electronics Division for complete information concerning AMP TAPER TAB RECEPTACLES . . . you will receive data and samples by return mail.

PHOTO SHOWS AMP SELF LOCKING TAPER TAB RECEPTACLES BEING APPLIED TO MATING TABS ON A STEPPING SWITCH. LOCKING ACTION GIVES MAXIMUM ELECTRICAL AND MECHANICAL SECURITY . . . CONNECTIONS ARE SUITABLE FOR CRITICAL LOW LEVEL CIRCUITS.



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AMP

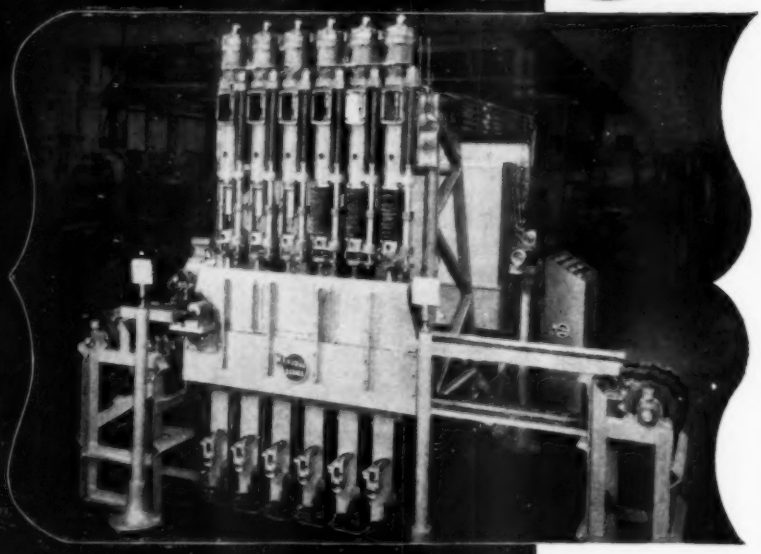
AIRCRAFT-MARINE PRODUCTS, INC.
2100 Paxton Street, Harrisburg, Pa.
Aircraft-Marine Products of Canada, Ltd.
1764 Avenue Rd., Toronto 12, Ontario, Canada

Cavity Facing and Shell Banding Equipment By

W.F. & JOHN BARNES

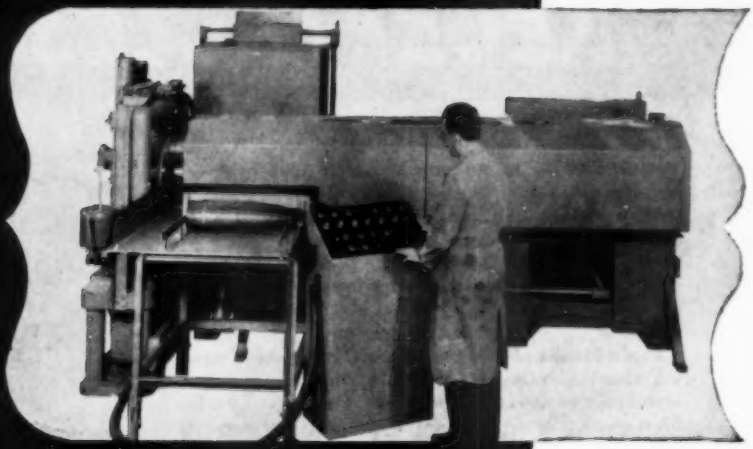
Over 1000 105 MM Explosive Shell Charges Faced Per Hour

Now face or drill cast or consolidated explosive shell charges fast, accurately and with full remote control safety. This Barnes Machine can be furnished to accommodate shells from 57 MM to 8" including 2.36, 3.5, 4.5 rockets and 81 MM and 4.2 mortars. Fully interlocked mechanisms eliminate operators from the hazardous area. Illustrated is a 6-spindle model; 2 and 4 spindle machines are also available.



Band Over 300 105 MM Shells Per Hour

The machine illustrated will receive the shell and the band, transfer them to the multiple jaw banding head, band in a single squeeze motion and eject the banded shell in a completely automatic cycle. A minimum of work hardening of the rotating band is a direct result of this single squeeze banding method. This machine will band either live or inert ammunition. Auxiliary equipment for the banding operations includes machines for band resizing, band deburring, band size checking and debanding. Infeed and take away conveyors, custom designed to suit your plant, can be furnished as a package with the Banding Machine.



Other BARNES Ordnance Equipment

In addition to these machines, the Barnes Company has designed and manufactured machines in the following categories:

a) Zone storage units,
b) Zone weigh handling mechanisms,
c) Fuze tensioning machines,
d) Custom handling devices for all phases of Ordnance work.

Complete electrical, hydraulic and mechanical facilities are available to coordinate these mechanisms into a smooth processing operation.

W.F. & JOHN BARNES

Free Additional Literature

is available on all Barnes Ordnance equipment. Since it is impossible to give the complete scope of operation in this restricted space, we invite you to write for the complete Barnes Ordnance book. Ask for bulletins O-154.

W. F. and JOHN BARNES

PROCESS EQUIPMENT DIVISION 308 SOUTH WATER STREET, ROCKFORD, ILLINOIS

How Sid Caesar and Stella Dallas help us build better radio and TV receivers for you...

Towering high above Rochester, N. Y. are the masts of our stations WHAM, WHFM and WHAM-TV. From them, Sid Caesar, Stella Dallas—and scores of others—are welcomed daily into the homes of Western New York, neighboring states and Canada.

But entertainment is only half the job these stations do for us—and for *you*. Less than a block from our main plant, their million-dollar studios make up Rochester Radio City—our broadcasting research laboratory. Through these stations we keep abreast of the latest wrinkles in broadcasting technique—and build receivers designed to deliver finest performance.

Since the very early days of radio in 1922, we've been in AM broadcasting; in FM, which we helped to develop, since 1939; and in TV, as the first station in Rochester, since 1949. And coincidentally we've pioneered some of the greatest advances in the world of home entertainment: automatic volume control, the coaxial cone speaker, and *"Panoramic Vision,"* to mention just a few.

What does all this mean to you?

You may not be planning to buy a new home receiver right now. You may never purchase a minute of time on any radio or TV program. But when you're considering *any* product bearing the Stromberg-Carlson name—whether it's a sound system, telephone equipment, electronic carillon, radio or television receiver—you can be sure it's backed by one of the oldest and most thorough engineering traditions in America.

There is nothing finer than a

Stromberg-Carlson®

Rochester 3, New York

STROMBERG-CARLSON LEADS IN:

Telephone Instruments and XY Dial Central Office Equipment

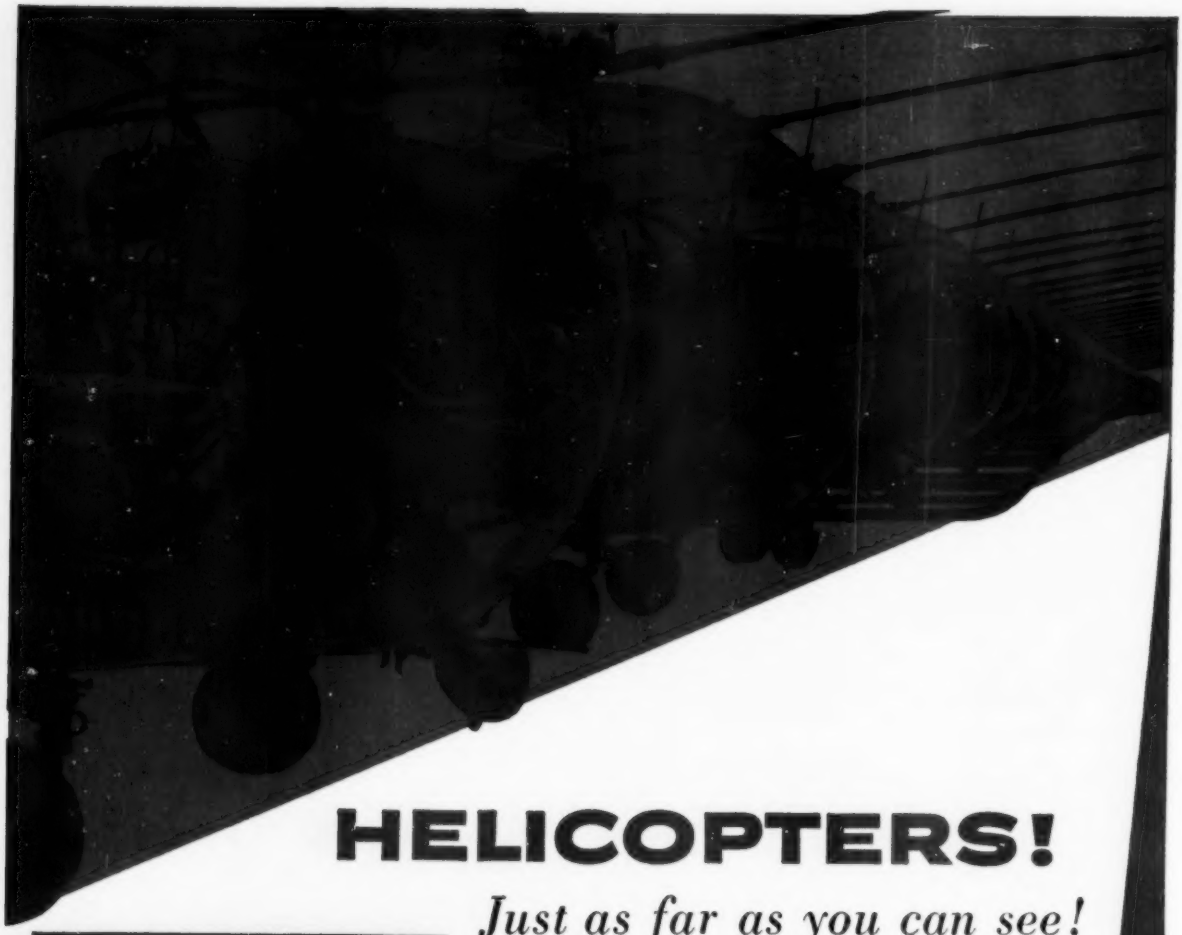
Sound and Public Address Systems

High Fidelity Radios and Radio-Phonographs

"Panoramic Vision" Television Receivers

Electronic Carillons

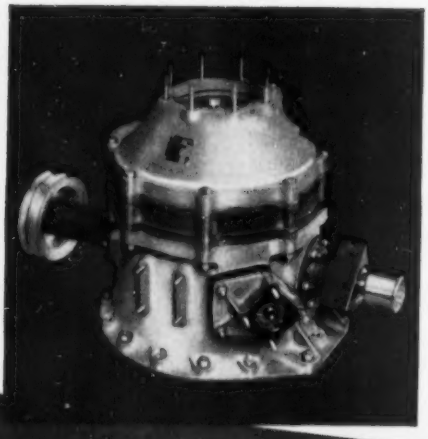
In Canada: Stromberg-Carlson Co., Ltd., Toronto



HELICOPTERS!

Just as far as you can see!

And with our precision gears they do the most amazing things!



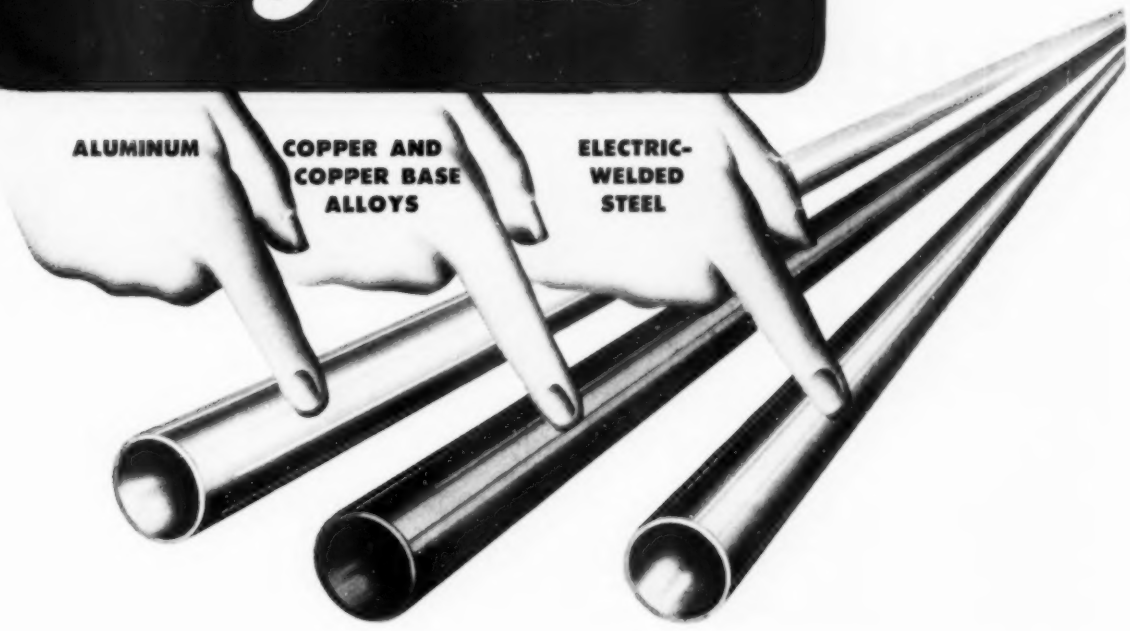
A lot of the performance in terms of smooth even power is due to the precision-made Rotor Transmission Manufactured by the Steel Products Engineering Company for the Bell Aircraft Corporation.

For 38 years we have been designing and producing gears, gear assemblies, and other components which have the highest possible precision characteristics.

THE STEEL PRODUCTS ENGINEERING CO.

engineers and manufacturers • Springfield, Ohio

Tubemanship in 3 metals



In government agencies and in defense plants throughout the country, you'll find Wolverine a "one-source" supplier of tubular products of copper (and copper base alloys), aluminum or electric-welded steel.

Ordnance experts, engineers, purchasing agents, and others have called upon Wolverine for millions upon millions of primer tubes and rotating bands—just to cite an example.

And Wolverine scores heavily for them because of one precious asset—Tubemanship—the twin qualities of skill and facilities. You see, Wolverine actually *surpasses* government specifications. That's normal at Wolverine.

On top of that, Wolverine's two modern mills are geographically located to assure speedy, uninterrupted delivery.

Wolverine supplies copper tubing in sizes ranging from 1/16" through 4½" O.D.—aluminum tubing from ⅛" through 2" O.D.—and welded steel tube from ¼" through 3" O.D.

You'll find information like this—and much, much more—in Wolverine's Statement of Scope. Write for your copy today.

WOLVERINE TUBE DIVISION, of Calumet & Hecla, Inc., 1499 Central Avenue, Detroit 9, Michigan.

EST. 1916

WOLVERINE TUBE DIVISION
OF CALUMET & HECLA, INC.
Manufacturers of Quality-Controlled Tubing

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA. • Sales Offices in Principal Cities

Another Industrial Leader...

The Texas Company

continues to build with

LURIA Standardized Buildings

During the past four years Luria installations for The Texas Company have been erected in various States.

ONLY LURIA offers you the SPEED and ECONOMY of STANDARDIZATION ...plus all the ADAPTABILITY and DURABILITY of CUSTOM-DESIGNED UNITS

Luria Standardized Buildings live up to their promise of high-speed construction coupled with low cost . . . of standardized design adaptable to almost *any* type of architectural treatment that best suits your *individual* needs . . . of permanent structures that meet and surpass the most stringent building code requirements. This is conclusively proven by Luria's outstanding record of *repeat* orders from the world's great industrial leaders . . . and from businesses of modest size.

If you are planning expansion now or in the future, the list of companies who *reorder* Luria buildings will impress you — just as the many advantages of Luria Standardized Buildings will interest you.

LURIA ENGINEERING COMPANY

ENGINEERS • FABRICATORS • CONSTRUCTORS

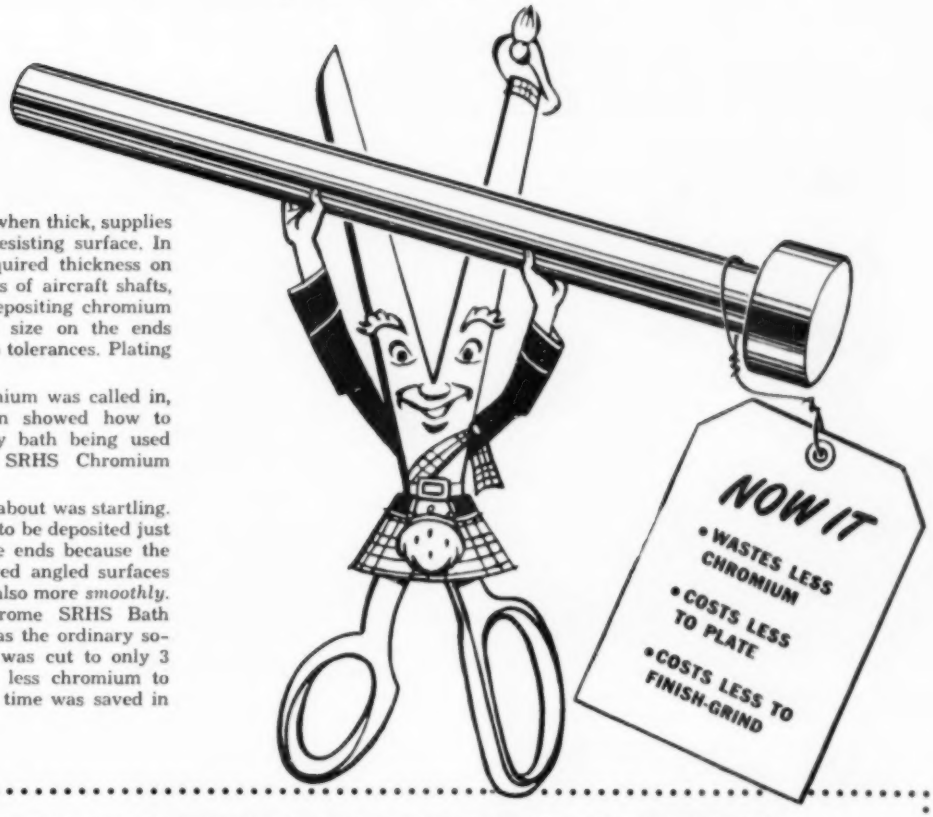
500 FIFTH AVENUE, NEW YORK 36, N. Y.

ATLANTA • PHILADELPHIA • BOSTON • CHICAGO • WASHINGTON, D. C.

LURIA *Customers are REPEAT Customers*

MR. COST CUTTER SHOWS HOW:

6-hour plating job gets cut to 3



CHROMIUM PLATE, when thick, supplies a hard, wear-resisting surface. In order to get the required thickness on right angle shoulders of aircraft shafts, one company was depositing chromium .012" beyond finish size on the ends and then grinding to tolerances. Plating alone took 6 hours.

When United Chromium was called in, the Unichrome Man showed how to convert the ordinary bath being used to the Unichrome SRHS Chromium Plating Solution.

The change brought about was startling. Chromium now had to be deposited just .008" oversize on the ends because the plate not only covered angled surfaces more *uniformly* but also more *smoothly*. Because the Unichrome SRHS Bath plated twice as fast as the ordinary solution, plating time was cut to only 3 hours. And with ⅓ less chromium to remove, still further time was saved in finish-grinding.

MORE WAYS UNITED CHROMIUM HELPS CUT COST OF COATING METALS

Uses half as much material

In six months time, a company giving zinc plated products a corrosion-resisting finish in Unichrome Dip Solution has used only half as much as former material. Solution lasts longer, too.

Packaging costs reduced

Producer could not ship concrete hardening solution in economical, ordinary steel drums because of hazardous chemical reaction on the steel. Successfully resisting the chemical, a Unichrome Plastisol Drum Lining ended the costly shipping problem.

75% saving on labor

Compared with cost of chromium plating small sewing machine parts in baskets, manufacturer estimated that the Unichrome Chromium Plating Barrel saves 75% on labor alone, and uses ½ less power.

TO FINISH IT BETTER AND SAVE

call in "The Unichrome Man"

UNICHROME

It pays to consult United Chromium on Metal Finishing Problems

United Chromium offers you the advantages of: (1) 25 years of specialized experience in metal finishing; (2) Wide experience in *both* organic and plated finishes; (3) A diversified line of products for decorative and functional finishing – including plating processes, protective coatings, chemical conversion coatings for zinc; (4) Thinking geared to *cost-cutting, product-improving* possibilities.

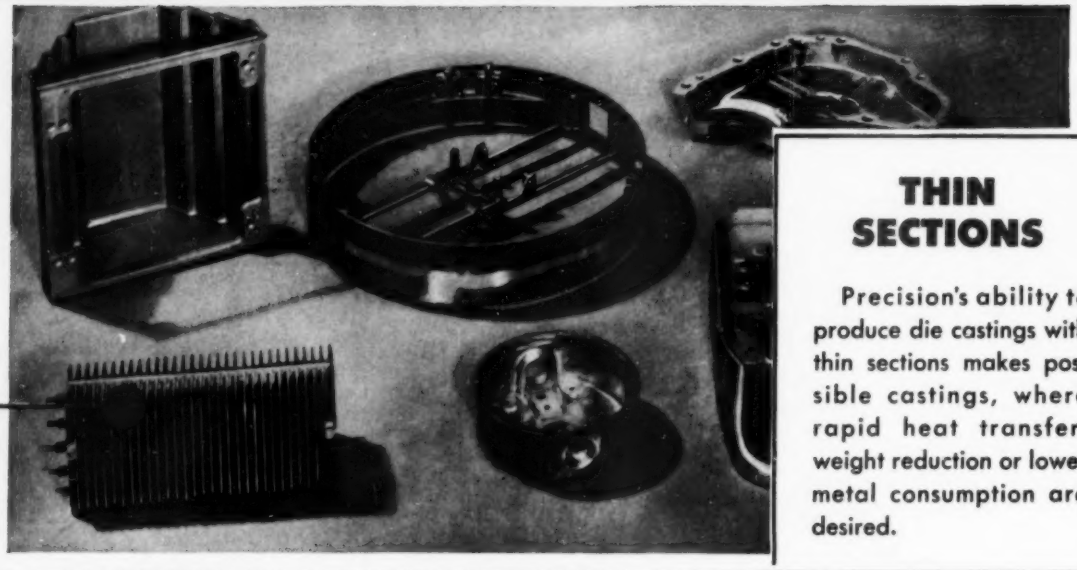
We'd welcome an opportunity to help you "Finish it better AND SAVE."

UNITED CHROMIUM, INCORPORATED 100 East 42nd St., New York 17, N. Y.

Waterbury 20, Conn. • Detroit 20, Mich. • Chicago 4, Ill. • Los Angeles 13, Calif. In Canada: United Chromium Limited, Toronto, Ont.

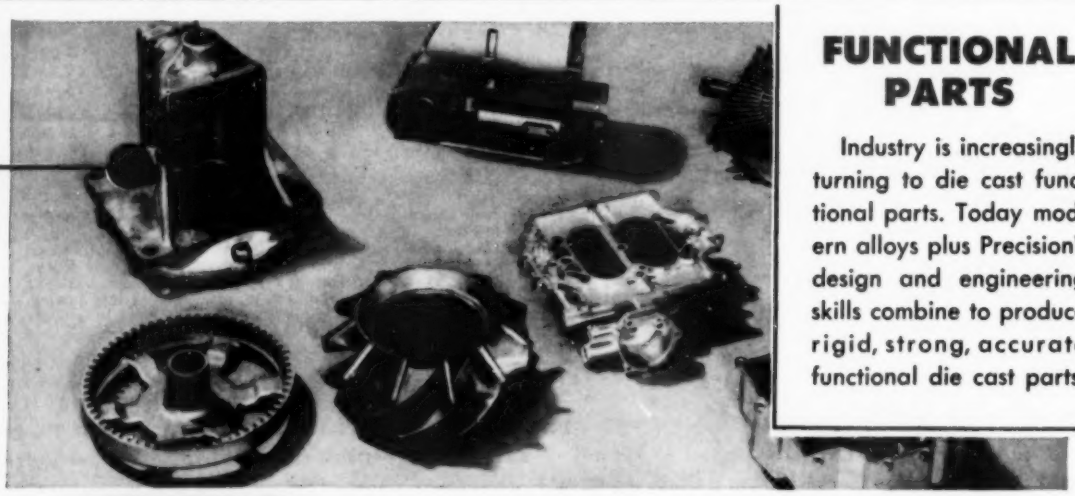
No Problem's Too Tough

when you call in ... PRECISION



THIN SECTIONS

Precision's ability to produce die castings with thin sections makes possible castings, where rapid heat transfer, weight reduction or lower metal consumption are desired.



FUNCTIONAL PARTS

Industry is increasingly turning to die cast functional parts. Today modern alloys plus Precision's design and engineering skills combine to produce rigid, strong, accurate functional die cast parts.

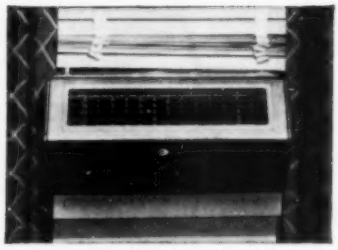
Since 1909 the name "PRECISION" has been the symbol of highest quality in the die casting industry.

PRECISION CASTINGS CO., Inc.
212 Walnut St., Fayetteville, N. Y.
Syracuse, N. Y. · Cleveland, O. · Chicago, Ill.
Kalamazoo, Mich. · Cortland, N. Y.
British Affiliation — Wolverhampton Die Casting Co., Wolverhampton, England

A VITAL FORCE IN NATIONAL DEFENSE

Chrysler Airtemp

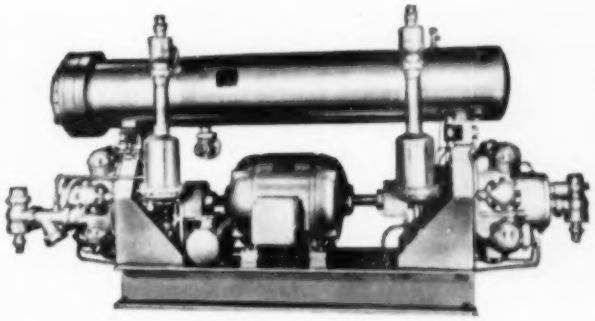
"Packaged" Air Conditioner
Easily installed. Cools, dehumidifies, filters, circulates, ventilates. Six water-cooled models, 2 to 15 H.P., and three new air-cooled models, which operate without water, require no plumbing, in 2, 3 and 5 H.P.



Room Air Conditioner
Fits in window. Cools, filters and circulates outside air. Ideal for offices, hospital convalescent rooms, workshops and other small areas. New model now available for use in casement type windows.

Chrysler Airtemp has won recognition as an outstanding factor in the national defense effort. By waging war against enemies of production, precision and perishables: uncontrolled dust, humidity and temperatures—Chrysler Airtemp is making a major contribution to the armament program. On all fronts—at home and abroad—in assignments that cover every application of temperature and humidity control, Chrysler Airtemp is serving with distinction. A complete range of products enables Chrysler Airtemp to provide the answer to production problems involving control of indoor atmospheric conditions.

Machine Tool Coolant Cooler
Keeps coolants in automatic machine tools at a constant temperature. Helps provide greater precision, higher production. Reduces friction heat.

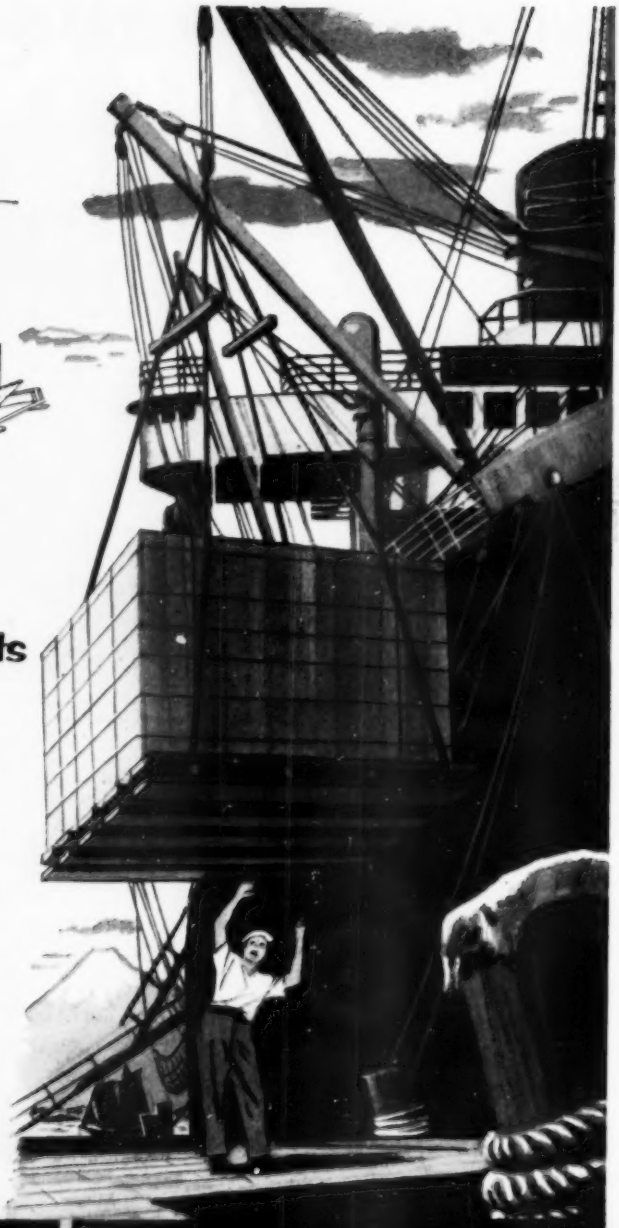


Central Station Unit
For large installations. This unit forms the heart of many air conditioning, cold storage and other temperature and humidity control systems.

Chrysler Airtemp

HEATING • AIR CONDITIONING
***for* HOMES, BUSINESS, INDUSTRY**

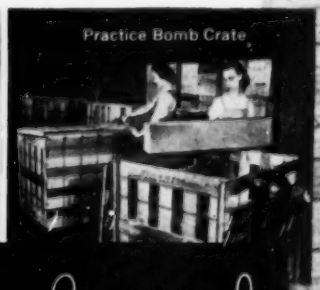
Airtemp Division, Chrysler Corporation, Dayton 1, Ohio



Everyday more and more service shipments go **WIREBOUND**

An ever increasing number of suppliers are taking advantage of improved Military and Federal specifications so that they may obtain the benefits of Wirebound containers for Armed Service shipments. They've found Wirebound box manufacturers well qualified to supply containers that meet government requirements for parts, equipment, over-packs, food and hundreds of other uses. Wirebound plants throughout the country are up-to-date on Armed Service shipping specifications and have the experience, technical know-how and testing facilities to produce the best container for each use. Why not check with your Wirebound supplier or write for full information!

Wirebound Box Manufacturers Association
Room 1163, 327 South LaSalle Street, Chicago 4, Illinois



Wirebound
BOXES & CRATES

75 WIREBOUND BOX PLANTS are ready to serve you!

Remington Rand Methods News

More Plants Slashing Maintenance Costs... Keeping Production At Peak

New Booklet On Preventive Maintenance Gives Flow Chart For Effective Control

Are *more than* 5 out of every 100 of your production workers doing plant maintenance? That's what a recent survey of manufacturing plants in the U.S. established! Is it any wonder that the latest developments in Preventive Maintenance Records, displayed at the Plant Maintenance Show held in Chicago in January, attracted sensational interest?

If you missed that exhibit, send today for our new free booklet X1383, showing in detail just how a planned maintenance control system works... how easy it is to install... how it insures maximum equipment productivity at greatly reduced operating cost.

These methods visually indicate what inspections are needed... permit scheduling of work ahead. Every man's time can be planned for maximum efficiency. Simplified visible methods provide tight control with paperwork streamlined to an absolute minimum.

The requirements of any such system are the same regardless of the size of the work force. They should include *all* of the following: 1) Written Work Orders 2) Scheduled Work 3) Equipment Records 4) Stores Control 5) Executive Reports.

Actually, maintenance management simply can't do a bang-up, cost-conscious job without a planned system with effective records providing all the facts for making sound decisions. The system offered in our booklet virtually gives you those facts at a glance!

Get this new booklet today. Study the flow chart showing effective Planning, Performing and Controlling of a Maintenance Program. See illustrations and descriptions of basic records which well-known plants are successfully using to put their maintenance operation on the same efficient basis as other operating departments. Ask for **X1383.**

Timken Roller Bearing Effects Big Savings Using Kard-a-Film For Personnel Records

Let this Certified Report written by an official of the Timken Company show you why personnel records need to be kept indefinitely... how an ordinary file drawer which formerly held 3,000 to 4,000 letter size records, now holds 250,000 documents!

Further, how Kard-a-Film records filed under the Variadex system makes for such speed of filing and reference that Timken now actually locates a "dead" personnel record as easily and quickly as one in the active file!

Read how Timken first tried microfilm on conventional reels only to find these unsatisfactory for a personnel records file. Kard-a-Film holds microfilm records on cards—all grouped by a particular subject rather than isolated

on a number of different microfilm spools. Documents no longer used can be kept up-to-date. Kard-a-Film Reader shows the records actual size right from the card and makes accurate inexpensive reproductions. Your personnel records are important to your company, your employees and others in your plant town get the benefit of Timken's experience. Get **CR867.**

Punched Cards Can Help Medium-Sized Plants, Too!

One west-coast tool manufacturer, with 675 employees, centered all its production-control, cost records, payroll, inventory control, sales analyses and special reports in *one* 5-clerk department with punched-card procedures.

In sales analyses alone punched cards gave them a report that previously took 37 days, *in the amazingly short time of 3 days!* In the words of their chief accountant:..."it would have been difficult to operate with anything like our present efficiency, without these economical and *complete* accounting controls." See **Certified Report 804.**

Do Your Filing System & Files Need Modernization?

It has been proved that 65% of the file records in the average company are useless... take up valuable space... slow down efficiency of the organization. It may pay you to call in a Remington Rand specialist and have him analyze your record-keeping problem. He has showed many leading companies how to increase efficiency and save lots of time and money. And this service is performed without disturbing or interrupting your daily operations in any way.

Our Business Services Departments recently made just such a study at the Newport News Shipbuilding and Drydock Company. Result: 60 years' accumulation of records are now streamlined and systematized... future expansion provided for... at great savings in money, space and clerical help. Reference is simple, whether it be to Hull No. 1 completed in 1891, or the new United States... which job alone, an official states, would have "buried" the company under "an unmanageable sea of paper" but for the "work done by Remington Rand experts". Read this interesting Certified Report written by an official of Newport News Shipbuilding. Ask for **CR850.**

Remington Rand

Room 1651, 315 Fourth Ave., New York 10

Please circle the literature you desire:

X1383 CR867 CR804 CR850

Name

Title

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Address

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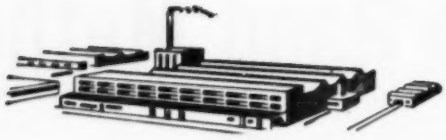
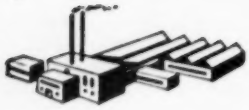
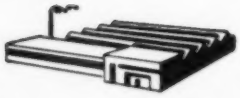
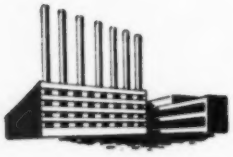
– Profit-Building **IDEAS** For Business –









PRODUCTS and FACILITIES Serving Many Industries

Pressed Steel Car Company offers a broad range of products and services available to industry throughout the world. Always alert to new processes and technological advances Pressed Steel Car Company throughout the years has maintained a reputation for more efficient, higher quality products.

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- *Locomotives and trackwork to cookware*
- *Agricultural and farm machines to milk cans*
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PRESSED STEEL CAR COMPANY INCORPORATED

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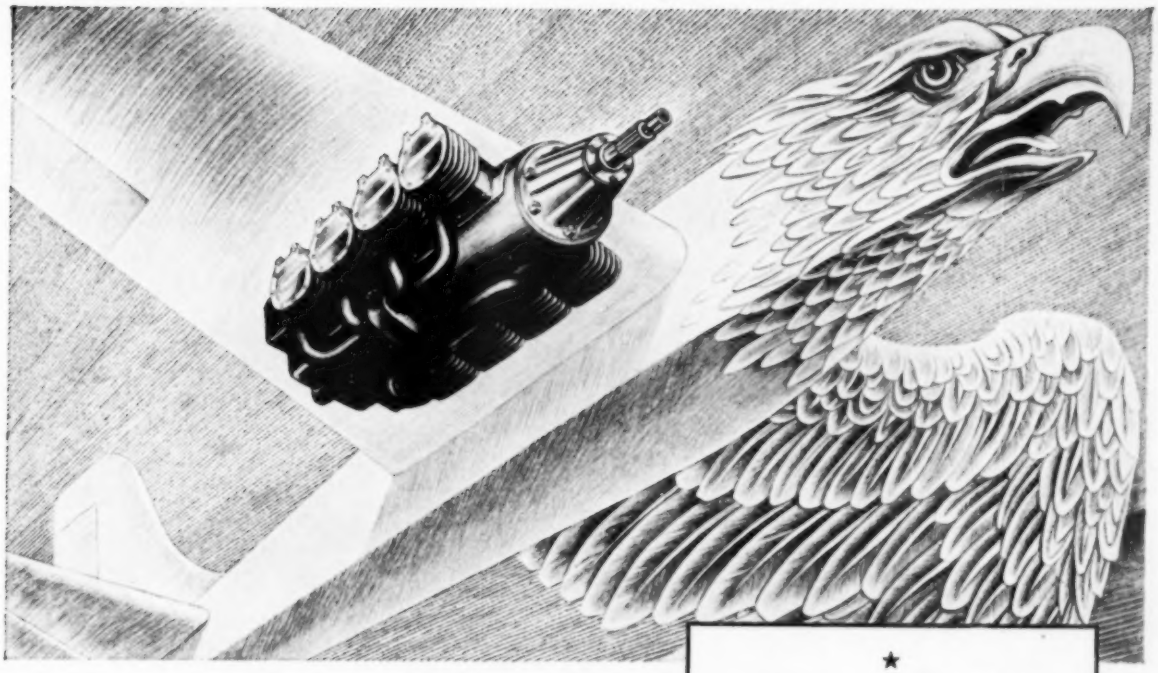

How **Lycoming** helps America grow stronger "wings"

Pioneer in air-cooled engines, Lycoming now makes important contributions to jet progress

Over 25 years ago, Lycoming created its first aircraft engine. Today, Lycoming builds 54 different reciprocating engines with a horsepower range from 65 to 1525—including America's only geared and supercharged air-cooled engines in the 400-h.p. class.

In the field of jet power, Lycoming produces high-quality precision parts and major assemblies. From Lycoming come engine components for J-47 jet engines . . . main leg cylinders for F-86 Sabrejet landing gear . . . complete gearboxes for J-40 jet engines.

Do *you* need dependable air-cooled power . . . precision parts . . . or any other of the diversified services listed with our signature? Lycoming's wealth of creative engineering ability . . . 2½ million square feet of floor space . . . and 6,000-plus machine tools stand ready to serve you. *Whatever* your problem . . . *look to Lycoming!*

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LOOK AT AMERICA'S LEADERS WHO LOOK TO LYCOMING

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LOOK TO **Lycoming**
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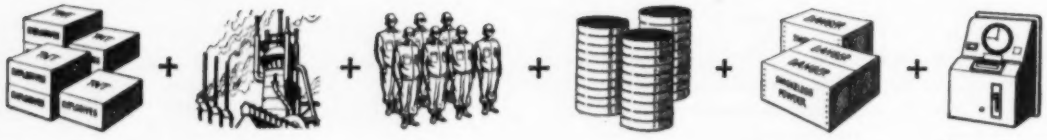
What It Takes to Fire a Howitzer Barrage



$2800.00 An Hour and worth every penny of it! Even though the cost of freedom might seem staggering in terms of a single howitzer barrage—in terms of civilian effort, our freedom is the biggest bargain in the history of mankind. On an average we work less than two hours a day to pay the cost of defending our rights and privileges as free men and women.

Skill and *speed* in our work keep freedom a part-time job... enables us to enjoy a richer spiritual and material life. But even if freedom were a *full*-time job, it would be well worth the effort as millions of enslaved people would testify... if they could.

Above figures are given with due regard to security.

AMERICAN MACHINE & FOUNDRY COMPANY

Executive Offices, 511 Fifth Avenue, New York 17, N. Y.

AMF does it better—automatically!

CREATORS AND PRODUCERS OF ELECTRONIC AND MECHANICAL EQUIPMENT FOR THE ARMED SERVICES: Radar antennae and drive units • automatic loaders for Army and Navy weapons • elevating and azimuth mechanisms • cooling fans for Army tanks • airplane parts • mobile ovens • electronic training devices • naval ordnance • rolled and welded steel products • shell components • silver-zinc batteries • special military projects.

SEALED-FOR-LIFE NEW DEPARTURES

Motors and machines equipped with New Departure Sealed ball bearings operate longer at peak efficiency with virtually no maintenance costs!

Automatically Service-Free!

Compact design . . . minimum maintenance costs . . . accurate alignment . . . smooth, dependable performance . . . these are just a few of the many advantages made possible by New Departure Self-Sealed ball bearings. No wonder so many motor and machinery manufacturers are already using N-D Seal bearings. In fact, since New Departure first introduced the N-D Seal, more than 255 million have been used in hundreds of applications throughout industry.

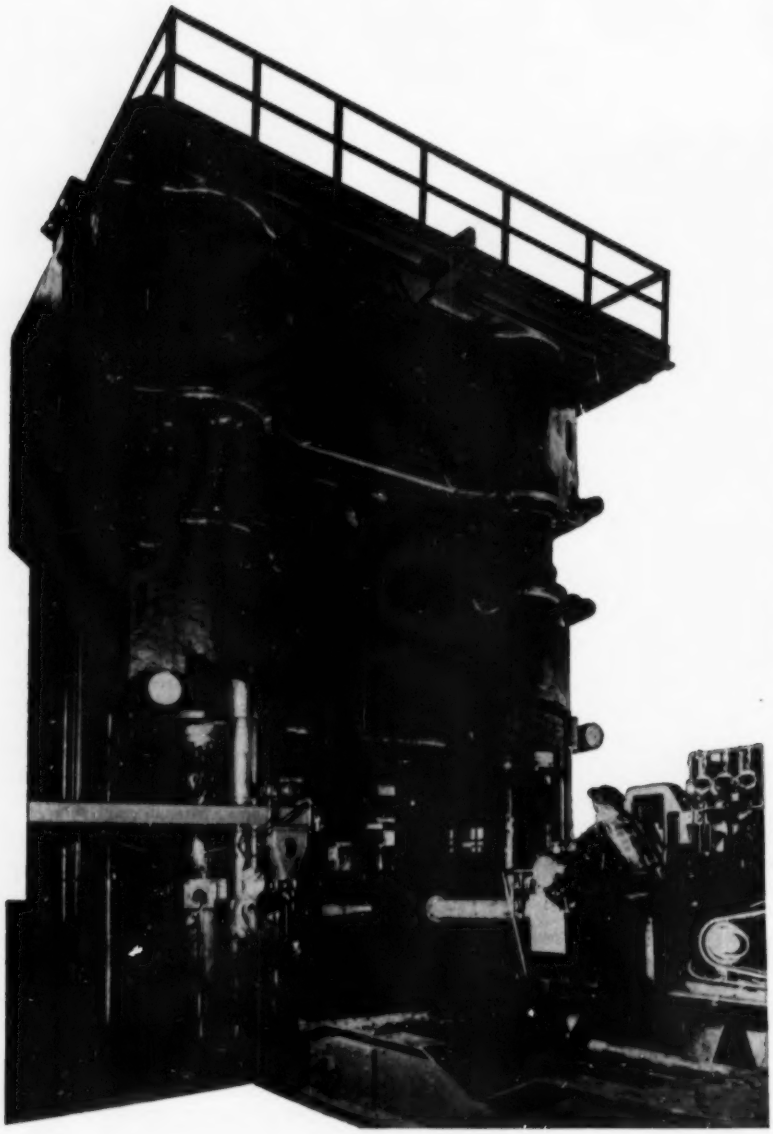
Why not call in a New Departure engineer and find out what N-D Seals can do for *your* product?

NOTHING ROLLS LIKE A BALL

NEW DEPARTURE
BALL BEARINGS

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT
Plants also in Meriden, Connecticut, and Sandusky, Ohio

FORGED
by Alcoa!



Lifted from a nearby preheating furnace by a giant manipulator, a 350-pound forging blank is brought into position between the polished dies mounted in the huge Schloemann press. Then, 15,000 tons of pressure flow the metal into a strong, complex shape—*another quality Alcoa® Aluminum Forging!*

The difference between this forging and others is more than a difference of size. The man at the manipulator, the man at the press control board are members of an Alcoa team which has had more aluminum forging experience than any other in the country. The alloy was developed, the dies were designed, and the metal-working temperature was selected by other members of this same Alcoa team.

As load requirements mount, aluminum forgings become the obvious choice in more and more aircraft applications. Your nearest Alcoa sales office—listed under "Aluminum" in your telephone book—is your short cut to 65 years of aluminum know-how. Aluminum Company of America, 850-A Alcoa Building, Pittsburgh 19, Penna.

Alcoa brings the world to your armchair with "SEE IT NOW" featuring Edward R. Murrow, Tuesday evenings on most CBS-TV stations.

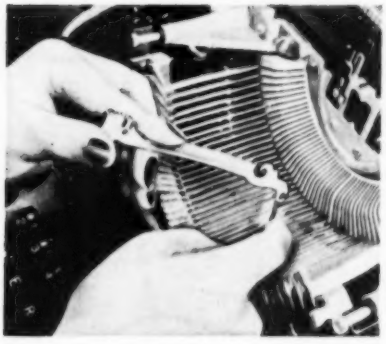
ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

With new Changeable Type Bars

IBM *Electric Typewriters*

really "speak your language"*



In your business do you need certain special symbols from time to time for typing letters, manuscripts and reports?

Then what you need is an IBM Electric Typewriter because Changeable Type Bars can be installed in every new IBM!

This revolutionary and exclusive Electric Typewriter development makes it possible to interchange in certain key positions regular and special type bars as needed. The wide selection of optional type characters includes scientific, mathematical, foreign-language symbols, and many other special characters such as subscripts and exponents.

The switch takes only 30 seconds—you simply unhook the regular key and hook the special key in its place—or vice versa.

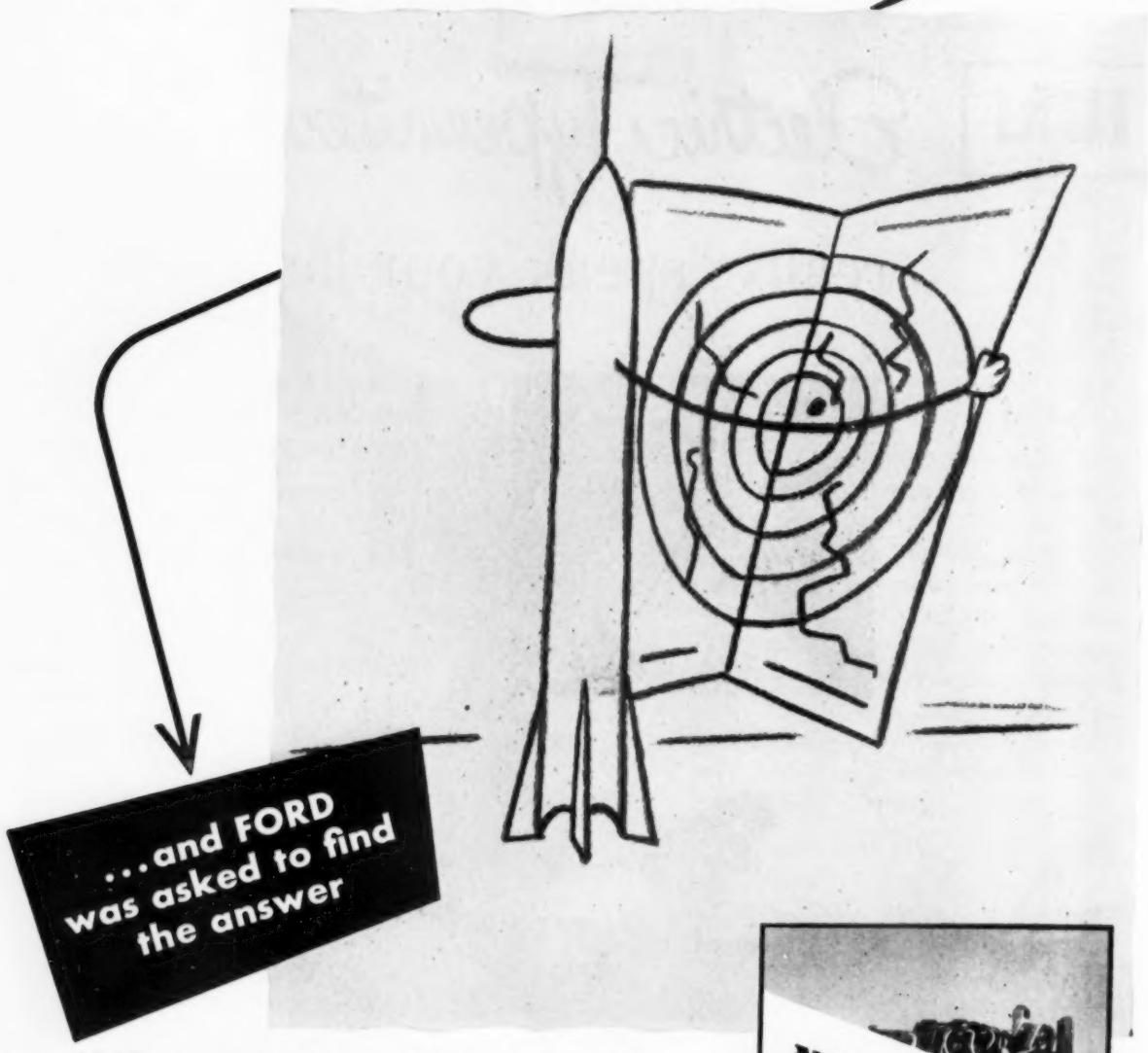
Tell us your special needs. We'll be glad to show you how easily and economically this new IBM feature can serve you.

For additional information write IBM, Dept. OR, 590 Madison Avenue, New York 22, N. Y.

INTERNATIONAL BUSINESS MACHINES

* $- \alpha = \varsigma \pm \leq \Phi \tau \Sigma \subset \beta \approx \epsilon \Psi - \acute{e} \Omega \sim \dagger \ominus + \Gamma \phi \geq \mp \xi \omega \equiv \P \pi \ddagger \Delta$

HOW TO TEACH A MISSILE
to read a map



Zwish! And off goes a missile. But where? And how to stay on the right track? And how to *find* the target? That's the problem Ford Instrument is helping to solve.

This is typical of the problems that Ford has been given by the Armed Forces since 1915. For from the vast engineering and production facilities of the Ford Instrument Company, come the mechanical, hydraulic, electromechanical, magnetic and electronic instruments that bring us our "tomorrows" today. Control problems of both Industry and the Military are Ford specialties.

12

You can see why a job with Ford Instrument offers young engineers a challenge. If you can qualify, there may be a spot for you in automatic control development at Ford. Write for brochure about products or job opportunities. State your preference.

FORD

FORD INSTRUMENT COMPANY
DIVISION OF THE SPERRY CORPORATION
31-10 Thomson Avenue, Long Island City 1, N. Y.

Smooth Starts

mean low operating costs

WHEN a rear-dump truck pulls away smoothly from a shovel with a 30-ton pay load – without jolts and jerks – it's sure to stay on the job longer with less down time.

Trucks equipped with Allison TORQMATIC converters and transmissions always start smoothly – because TORQMATIC DRIVES absorb these shocks instead of transmitting them to other truck parts.

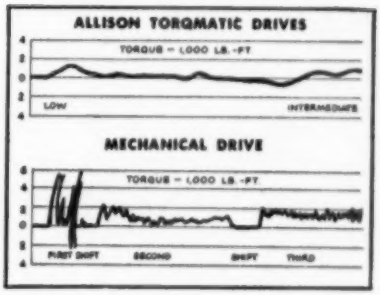
To demonstrate this, Allison engineers measured power-train shock loads in a large number of earth-moving, coal and ore-hauling trucks under both normal and extreme operating conditions. These charts show the results.

Trucks equipped with Allison TORQMATIC DRIVES showed starting shock loads four times less severe than trucks using mechanical drives. Furthermore, trucks equipped with Allison TORQMATIC DRIVES were *quick-shifted* at full throttle.

If you're operating off-highway trucks or other heavy-duty earth-moving equipment, specify Allison TORQMATIC DRIVES, the matched team of torque converter and hydraulic transmission. Ask your dealer, equipment or engine manufacturer for further information or write to:

ALLISON *Division of* GENERAL MOTORS
Box 894 -00, Indianapolis 6, Indiana

POWER-TRAIN SHOCK LOADS



Note the jagged line – shock loads – as the mechanical drive truck pulls away from the shovel and shifts from first to second gear. Compare the smooth line – no harmful shock loads – for the truck equipped with Allison TORQMATIC DRIVES.

MATCHED UNITS BUILT BY ONE MANUFACTURER

Allison TORQMATIC DRIVES

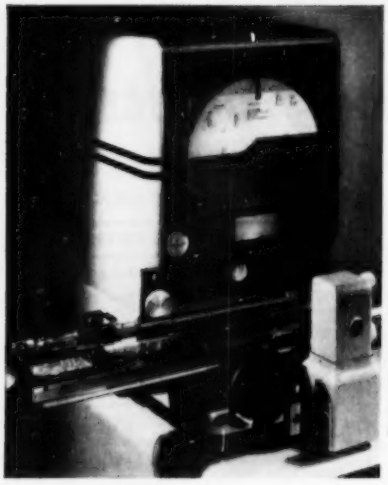
COMPACT, EFFICIENT HYDRAULIC DRIVE FOR TRUCKS • CRANES • TRACTORS • SHOVELS • DRILLING RIGS • SCRAPERS

Are you overlooking the versatility of optical gaging?

If you have been thinking of optical gaging only in terms of shadow projection, you may be missing an opportunity to lower your inspection costs, speed the work. By modern optical gaging techniques, you can inspect:

LARGE PARTS

A tracer is used to transfer related points on this large piston within the limits of the comparator screen.

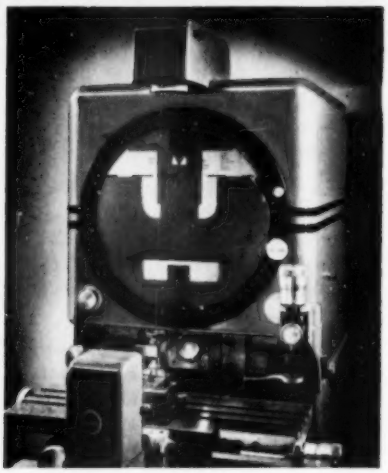


LONG PARTS

An accurate index bar positions various shoulders of 27″ long drive shaft for checking 22 critical dimensions.

DIMENSIONS YOU CAN'T SEE

A double target plunger is used to check 4 dimensions on this gun part that can't actually be projected.



Fast, accurate, and economical, optical gaging may well be adaptable to your production inspection requirements. We welcome the opportunity to show you how. Just send us your part specifications with critical dimensions indicated for our analysis.

OPTICAL GAGING PRODUCTS INC.

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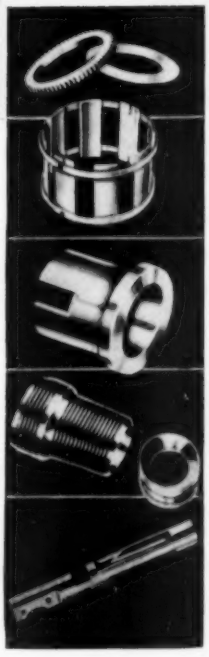
The BASIC SHAPE of things to come!



● When you use Shelby Seamless Mechanical Tubing for hollow cylindrical parts, the basic shape—the tube—is already made.

You pick up the job where Shelby leaves off, and you find that it requires much less cutting or boring than solid bar stock or forgings would.

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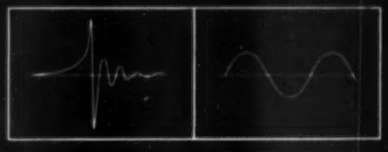
A new machine that solves more data recording problems than any new instrument since the oscillograph



Like the direct magnetic tape recorder, the AMPEX 306 presents data in "live" electrical form that can be scanned, speeded up, slowed down, automatically reduced or converted to any electrical, visual or physical form that might be desired.

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AMPEX 306
Magnetic Tape Recorder

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- Recording of explosions, shock waves, geophysical data and other phenomena of a highly transient nature.
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- Data whose complexity and quantity makes automatic reduction, scanning or comparison desirable.
- Non-repeatable test situations requiring high reliability and comprehensiveness of data.

For further information write today to Dept. L-1039D

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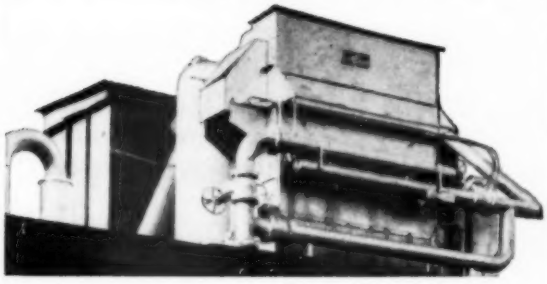

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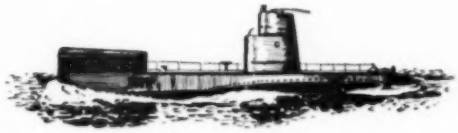

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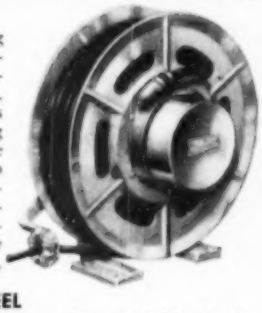

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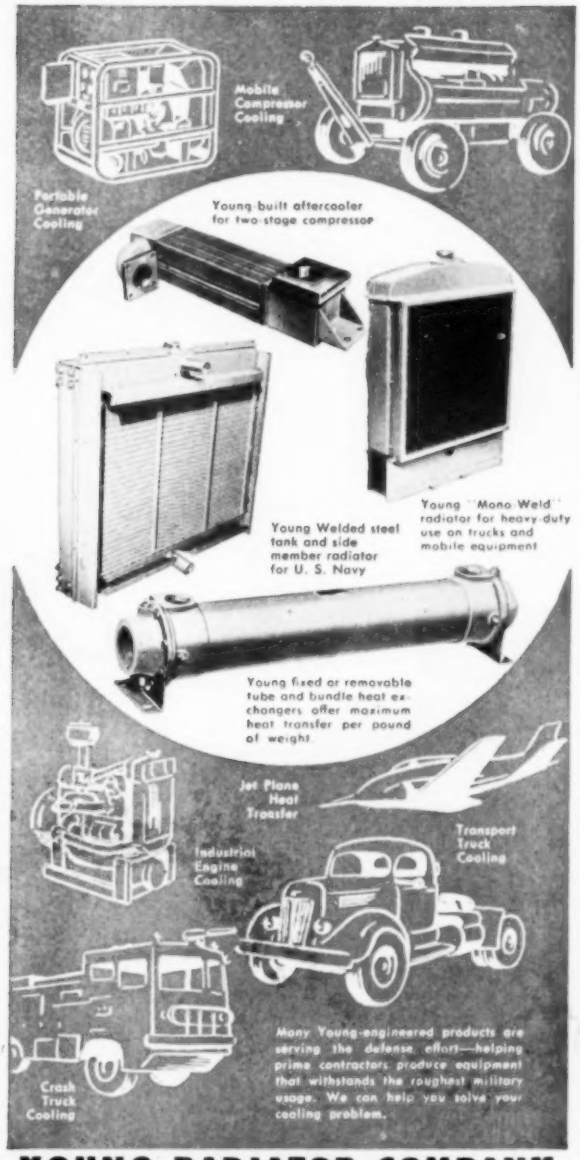
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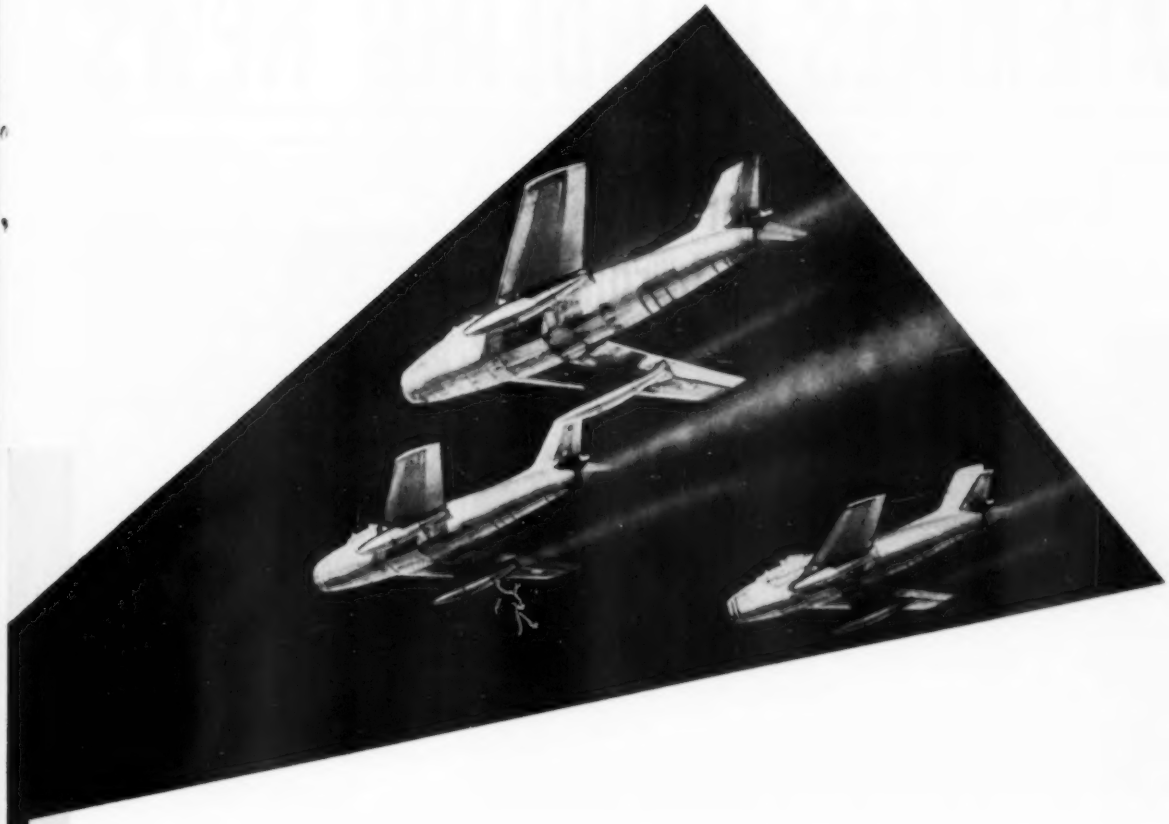
Time and Distance —
They were weapons that gave us the chance to win — yesterday —
To preserve the freedom we enjoy today.

What will save our freedom in the years to come? —
For our future and the future of our children —
Now that Time and Distance are no more —
Devoured by the swift wings of supersonic planes?

Look out the window. What do you see?
A peaceful city — the ferryboats plying their way across the river;
Or the smokestacks of your factory, busy with the tasks of peace?
Is that all?

You've missed something — factories halfway round the world,
working night and day, preparing the latest implements of war.
For what? To blast your factory — turn your peaceful city into
a shambles — wipe out your freedom.



What's the driving force behind all this hostile activity?
The foresight and imagination of zealous men who hate what you love
and love what you hate.

Are they smarter than we?
Do they know what they want more clearly than we?
Can they plan for the future more intelligently than we? —
Their future — to supplant ours?

Do you know any magic that can take the place of foresight?
Any fancy words that can do the work of hard, conscientious planning now? —
Any miracles to rely on as substitutes for intelligent preparedness?

The American Ordnance Association doesn't either.
That is why it works to develop the finest team of scientists
and industrialists, to cooperate with our military experts,
to perfect the best armament in the world —
and factories ready to augment its production — at a moment's notice.

All men of vision and understanding, with the will to win, are
welcome in this effort — essential to your economic and physical survival.

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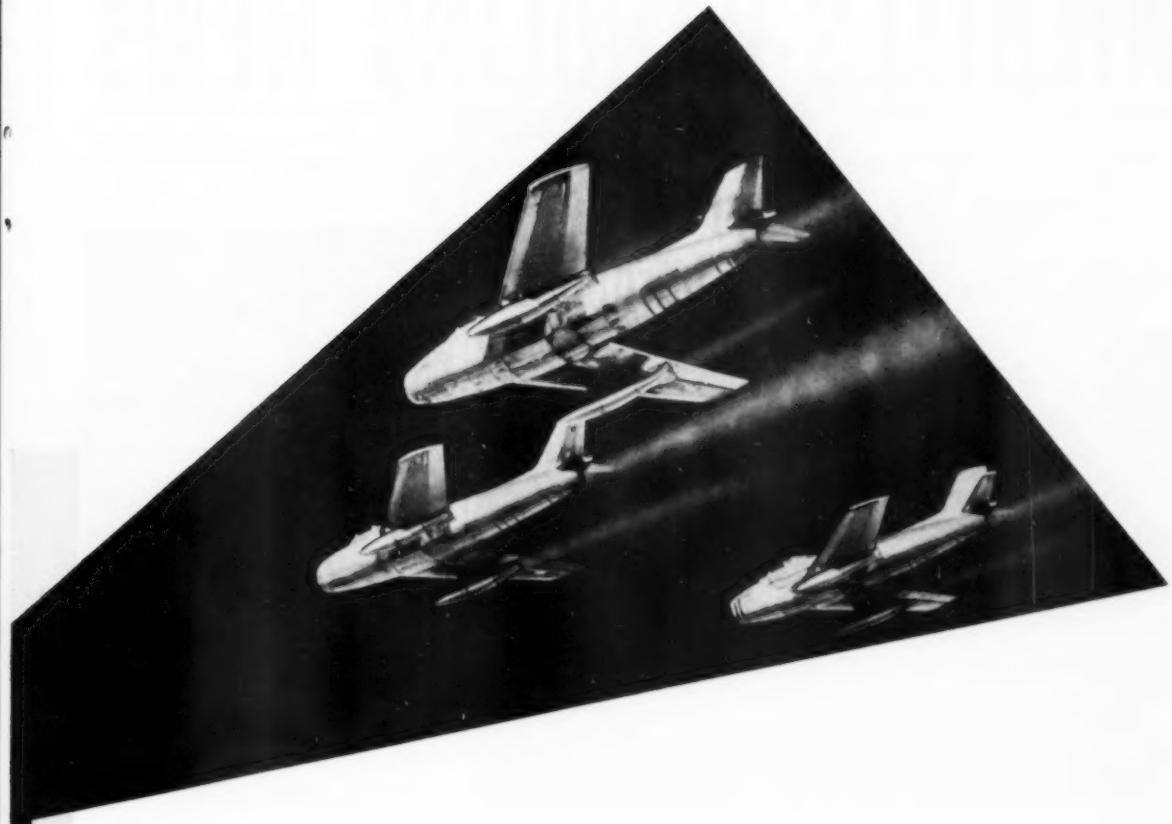

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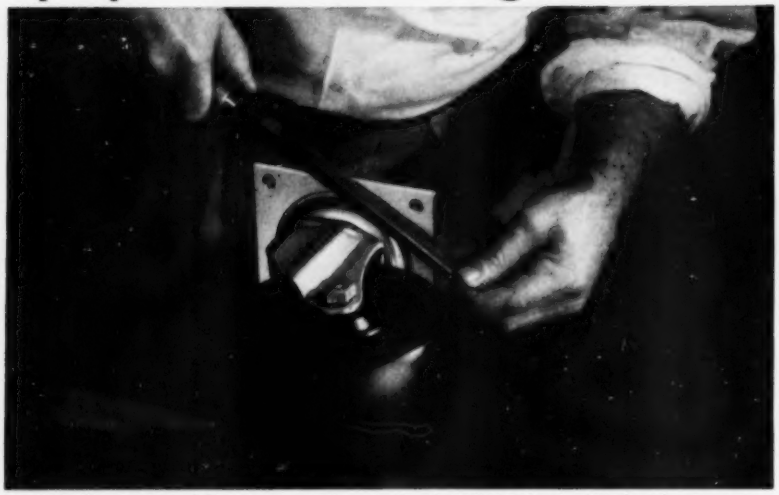
MATERIALS-HANDLING NEWS

★ Panel Discussions by Bassick, World's Largest Manufacturer of Casters and Floor Protection Equipment ★

Simple file test proves proper swivel bearing hardness



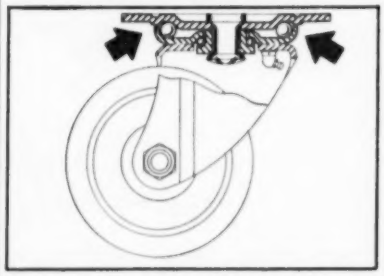
Hard? Filing action fails to cut uniformly hard (15N90 Rockwell) bearing raceway surface — showing you get *more-for-the-money* service life when you specify Bassick double ball-bearing cold-formed steel casters.

File-hard bearing surfaces

Bassick's deep full case-hardening process employs Leeds & Northrup electrically controlled "Homocarb" furnaces to assure "file-hard" ball and raceway surfaces of uniform depth and value of hardness. This eliminates premature wear or failure of these vital swivel bearing parts of all cold-formed double ball-bearing steel casters.

Try this simple file test in comparing the caster you are now using with a Bassick cold-formed double ball-bearing steel caster (series H99, S99, 68, H68, etc.). More-for-the-money service life is assured since Bassick's "file-hard" bearing surfaces are highly resistant to wear or damage.

Cross-section shows location of case-hardened parts



All surfaces of swivel bearing parts are full case-hardened *all over* — note heavy lines. Unlike so-called "coin-hardening" or its synonym "work-hardening", which reflects only a change in metal density as a by-product of cold forming metal processes, Bassick's controlled hardening process after forming provides completely uniform hardness depth and "file-hard" (15N90 Rockwell hardness) surface value.

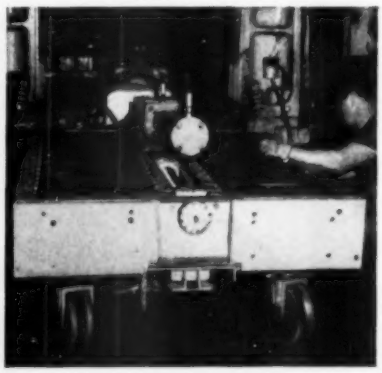
Full case-hardened and cupped raceways give you longer service

On light-duty trucks and dollies, series "68" caster gives easy action. Load ratings up to 800 lbs. per truck.

Shop trucks and mobile equipment move easier on new low-cost series "H68" caster for loads up to 1400 lbs.

For medium and light-duty jobs, use rugged series "H99" caster with load ratings up to 4000 lbs. per truck.

No "man-handling" here



Tired of wrestling with heavy dies?

Take a tip from Fairchild Aircraft, which built this hydraulic die wagon and equipped it with Bassick grooved-wheel casters. They're the best solution yet to the problem of moving materials frequently over a fixed route.

Accurate Control

This ingenious wagon employs hydraulic power to place and remove press dies. It completely eliminates laborious man-handling with the help of chain falls and skids. Bassick grooved-wheel casters permit accurate control of wagon, make movement 3 times easier than flat wheels in direct contact with floor. They roll on easily installed angle iron track which is inexpensive and self-cleaning. They're made in both swivel and rigid types, with wheel diameters of 4″, 6″, 8″ and 10″.

Write for facts

We'll be glad to supply more data on the Bassick products you see here. Bassick makes the world's largest line of casters, assuring you the right type for any moving job. Check your Bassick industrial distributor or write us direct.

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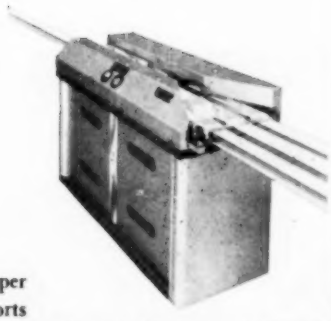

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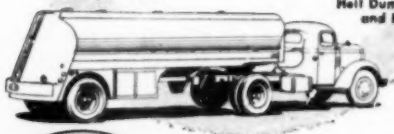

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Throughout the years the word "Ordnance" has been to America a symbol of constant research and production devoted to strengthening and protecting our country. On the occasion of its 50th anniversary, Burgess-Norton salutes these engineers and production men of the Army, Navy and Air Force whose skill and untiring efforts have been such an important factor to our freedom.

B-N has had the privilege of working on the Ordnance-Industry team for many years . . . producing brush axes during the Mexican border raids, shell components in World War I, and tank track components and other precision parts in World War II and during the Korean conflict.

Today, Burgess-Norton is proud to be able to offer to Ordnance constantly increasing experience and facilities for research, development and production.

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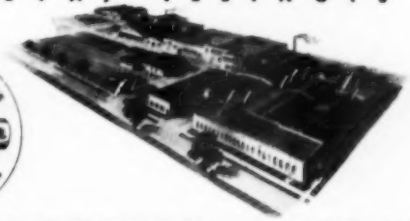

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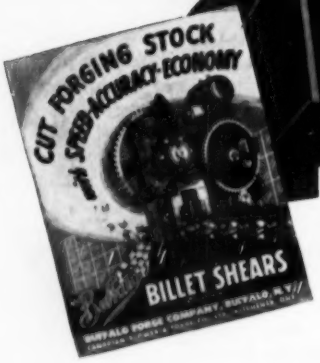

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ARMAMENT TECHNOLOGY

This section of ORDNANCE contains articles of a detailed and technical nature on ordnance research, development, manufacture, field use, and related subjects.

Logistics of Necessity

Transportation systems, not organization tables, are the keynotes

Capt. John D. Hayes, U.S.N.

Industrial College of the Armed Forces, Washington, D. C.

SOME months ago in this magazine it was stated that "a revolution in the methods of warfare took place between 1942 and 1945. This revolution took the form of applying industrial potential to military needs. The ability of Americans to produce war materials in vast quantities and to manage large supply lines enabled our combat people to apply the military principle of mass in a new manner. Logistics rather than strategy or tactics was used to assure victory." ("Military Command or Management," Vol. XXXVII, No. 197, p. 802.)

This revolution in warfare within the military profession is still going on. It is part of the great industrial-scientific mass-production revolution of the nineteenth and twentieth centuries. It has manifested itself most impressively in our two great twentieth-century wars.

LOGISTICS assured victory in each of these, but the logistics way of war has always been the American way. Despite continued military success we are basically a nonmilitary people. Ours has always been a strange combination of detesting war and having a competence for it, especially logistic competence.

This logistic pattern in American warfare became evident in the first of modern wars, our Civil War, when railroads and the telegraph were first used in warfare. Railroads have had two lasting military effects on a world made smaller by mechanical and electrical energy. First, continental strategy, which the horse had made dominant in ages past, could again match maritime strategy. Secondly, the Clausewitz philosophy of the nation in arms could be realized.

Modern transportation is now available to move the nation in arms, with modern communications to direct it and modern mass production to support it. In our Civil War the railroads and telegraph made possible the great encircling movements of the western Union armies.

In the short European wars of 1866 and 1870 the Germans used the railroads and the telegraph to effect strategic perfection, and the German General Staff gained a reputation it was never to match again.

BUT the mass armies that could be moved by railroads and directed by electric communications also needed mass-produced supplies, as the first World War was to indicate so forcibly. In that war, mass armies stalemated under their own weight, and tactics bogged down into mass frontal attacks.

The dependence of modern mass armies on logistics still keeps tactics sterile. The peasant armies of China revived tactics for a time in Korea, to the distress of the surprised logistics-bound Americans.

In the Second World War, strategy also went into shadow and became the servant of logistics rather than an in-

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strument of national advantage. Today logistics has become the *sine qua non* for our whole pattern of national security.

The logistics of plenty, for that is what this type of logistics essentially is, has now become the American way of war just as mass production has become the American way of life.

Clausewitz indicated the possibility of the logistics of plenty. The Germans first tried it, but it was the Americans who perfected and succeeded with it.

The logistic pattern is only one facet of American thinking about war. The other is the illusion that war and peace are two separate conditions of national life with war being the aberration—something disturbing and to be gotten over with. Wars are to be short, total, and complete. Every war must be a war to end war. To do this, warfare is made intense, the enemy must be smothered, and a logistics of plenty has to be used.

Americans to their sorrow now realize that their short but intense wars of the twentieth century have not insured against the possibility of future wars. Instead, today we find ourselves in a situation where peace and war can no longer be sharply defined, and the prospects are that this situation will be with us for a long time.

This has resulted in some stock-taking. We took a terrible toll of our resources in the last World War. Today we see Great Britain a prostrate victor of two exhausting wars with victories that cost a generation in the first and liquidated a mercantile empire in the second.

IT is the military man's job to keep our country unconquered and unconquerable, but he and his fellow Americans want to keep for their descendants something of the heritage that made the United States great in the first place. For the question can be asked, "If we insist on a logistics of plenty can we be sure of having an American way of life?"

Two problems currently face U. S. military people. The first is devising a better integration of strategy and tactics with logistics so that the latter does not completely dominate. The second is the substitution of a dynamic logistics of necessity for the vast, sluggish logistics of plenty. The first inquiry is outside the scope of this paper. Only the second will be discussed here.

Until strategy and tactics again come into the ascendant in the military profession, it is in the field of logistics where the challenges will be found, and it is in this field where creative military thinking is needed. A philosophy of logistic necessity must replace that of plenty in the minds of the military.

THERE is a conscious realization of this today as military programs are being influenced and determined by the economic situations existing throughout the world. It is the logistics man who has to adjust the programs accordingly. He must listen on one side to the diplomat and strategist and on the other to the economist and man with the purse strings.

When the factors do not all add up into a satisfactory pattern he must do what a military man is supposed to do in such circumstances—he must take a calculated risk. With the philosophy of logistic plenty predominating, logistics people were not noted for taking such risks. Perhaps they were not allowed to.

But under the dynamic logistics of necessity, the logistics man has the job of making feasible those strategic plans which are suitable while at the same time regaining the confidence of the American people in the way their money is being used for national security.

If military people are to retain control of their own destiny, if they are to have the freedom of action and the confidence that has always been theirs, the logistics man must rise to new heights.

The term "logistics" is used here, not in the narrow sense of direct support to combat forces and fleets but in the generic sense of the entire support which an economy and a way of life devotes to preserving itself.

"Logistics" is preferred to such terms as industrial, economic, or defense mobilization because it has had a more constant and inclusive meaning and indicates a continuity throughout the whole support process in war. It can be divided appropriately into parts such as national and military logistics; Army, Navy, and Air Force logistics; or, as the Navy uses the term, into consumer and producer logistics.

It can be used for the concepts being discussed here—the logistics of plenty and the logistics of necessity.

Our time has brought forth a new social science—that of equating the demands of national security with the ability of an economic system to meet these demands. The economists have not come up with a satisfactory term for it yet. Perhaps it would be better if military men supplied this need. The term "national strategy" has come into general use—why not national logistics?

The new logistics of necessity means bringing back and stressing once more that neglected principle of war, *simplicity*. The one real constant in this era of rapid change is the capacity and capability of a human being. Modern organization, especially modern military organization, has of necessity become complex. If such organization is not to get beyond human control, its processes have to be kept simplified, and a continuous campaign for simplification must accompany the growing complication.

Today military organizations are large and important parts of our economic and industrial life. They function to a large extent as do big industries, except that they are larger and more complex.

Logistic rules and processes of a generation ago will not suffice today. Simplification and adaptation to new conditions are the challenges to leaders and managers in our military establishment.

Two general approaches can be made to this problem of simplifying modern logistics. The first is simplifying the organization of the military itself. This involves a clash of philosophies, and the battle has been going on for years. I do not propose to get into it here. Instead, the rest of this paper will be devoted to a discussion of the simplification of logistics within our present organizational structure.

MANY methods of simplifying logistic processes suggest themselves. I propose to deal with only three. The first can be demonstrated by a hypothetical case of a homely nature. Suppose you as a commander of an operational unit have been issued a piece of equipment for use in battle or battle exercises. A small spring in that equipment breaks and is replaced by its only spare. You do

not like to be in that position nor do you like to imagine yourself or any one else in that position again. So you demand two spares for that spring.

Since your demand represents field experience for inventory and mobilization purposes you have created a material requirement which is translated back through the logistic system with increasing significance.

The supply of that spring in the depot is increased, more manpower and raw materials are needed to produce this increase, and mobilization requirements for it are made that much larger. The decision to require an additional spare part is not questioned.

What is being attempted here is to show the influence that minor logistic decisions can have on service and national requirement aggregates.

The second means of simplification is the reducing of operational logistics to a smaller but more fluid function. By way of explanation let us refer for analogy purposes to a formula which was familiar to many of us at one time:

$$E = \tfrac{1}{2} MV^2$$

where E is kinetic energy, M is mass and V is velocity. My analogous formula is:

$$L = f(MV^n)$$

where L is *dynamic logistics*, M is mass of supply or *inventory*, and V is velocity of supply or *transportation*. Translating this mathematical formula into understandable English, *dynamic logistics* can be said to depend both on inventory and on various means of transportation.

If the V^n part of the formula is eliminated, it becomes:

$$L = f(M)$$

THAT is, L varies only with M or logistics depends only on inventory. Such logistics can be said to be static. Our trouble today may be that we consider logistics too much from this static point of view. Such a viewpoint might have been the proper one when military organizations were small compared with the rest of the economy and when transportation was so slow that it could be eliminated as a factor.

Today, however, instead of thinking of logistics in terms of tables of organizations, allowance lists, and pipe lines, we should be thinking of it in terms of our marvelous transportation systems—land, sea, and air.

We know what air transportation can do. We have the example of the Berlin airlift—a dynamic logistic accomplishment that became a political victory. The Navy's mobile support force keeps our task fleets in Korean waters and in the Mediterranean without the need for bases. The Red Ball Express kept the war going in Europe when all the conventional systems of logistics fell down.

The point to be stressed here is that when the demand for L in the formula increases we should give more attention to the V instead of just increasing the M. Then we would eventually learn to do what American industry is already doing—operate with small inventory.

"Until strategy and tactics again come into the ascendant in the military profession, it is in the field of logistics where the challenge will be found and it is in this field where creative military thinking is needed. A philosophy of logistic necessity must replace that of plenty in the minds of the military."

What is the ratio of an automobile dealer's inventory to his sales? How does modern industry supply or obtain critical spare parts? The logistic man's problem are the same in essence if not in extent as those typified by these questions.

The third method of simplifying logistics within the present system is one directed at improving our vast military requirement and procurement program. This method could be called *nonspecific buying*. Industry is expected to produce military goods as well as civilian goods by mass-production methods. But the methods of specifying the products that are wanted in each case are entirely different.

As civilians we get what we want by expressing our needs in the most general and indirect form and leave to industry to produce for us articles that are low in cost and high in quality. American industry does a good job of meeting our needs and wants. As a result, specifications are almost unheard of in the consumer-goods industries these days.

All would admit that making a modern automobile to our specifications would be ridiculous, and all know the financial hazards stemming from incorporating too many personal ideas into the plans of a new house.

But as military men we still use the "made-to-order" system. We insist on rigid specifications and on stopping production lines to make changes. Considerations of perfection are important, but in peacetime they increase costs and in wartime decrease quantity.

ON the other hand, modern industry, instead of striving for perfection, strives for quality, a more relative category. Industry's goal is the integration of low cost, large quantity, and high quality. It is natural for the military man to want perfection for, unlike the industrialist, his competition admits of no second place. But even for him the integration of quality with quantity is better than perfection alone.

There have been many cases where industry produced a better and at the same time a cheaper article than the military prototype.

"To improve the stream, begin at the source." The source of the trouble in determining military requirements is not in the Pentagon but in the operating units in the field, in the fleet, and in the wings. It lies also in the military concept of a need.

An operational or combat need is a need only when it is real, not ideal or imagined. A need to be real first must have a situation which creates it. That need must then be filled by the logistic people in time to prevent failure or insure victory, as the case may be.

Filling combat needs with a minimum of American resources is the criterion of logistic success. Lack of a yardstick for measuring such success today prevents the *logistics of necessity* from becoming a reality. To find one is a challenge addressed to both logistic and operational people in all the armed services.

The opinions and assertions expressed in this article are those of the writer and are not to be construed as official or as reflecting the views of the Navy Department, the Naval Service at large, or the Industrial College of the Armed Forces.

Aberdeen in Korea

The Eighth Army Ordnance School provides facilities for the training of mechanics and maintenancemen in the highly technical skills necessary to repair and service equipment overseas

Pfc. Charles A. Reynolds

A MINIATURE counterpart of the huge Ordnance operations at Detroit and Aberdeen Proving Ground may be found in Yongdung-Po, an industrial suburb of Seoul. Not a sprawling giant, like its bigger brothers, the Eighth Army Ordnance School is a compact, tight organization that carefully screens its students for comprehensive, yet highly technical courses.

Reasons for the forming of the school may be traced originally to these four factors:

1. Arrival of new types of material, some not originally scheduled for this theater, with which few people in the theater were familiar;

2. Continual rotation of personnel, causing constant loss of trained men and requiring continuous training of replacements for them;

3. Shortening of training periods in the United States, resulting in arrival of many men only partially trained in Ordnance subjects;

4. Realization, based on theater experience, of the need for special courses, such as cannon-evaluation and instructor-inspector techniques.

THE origin of the school may be traced to the experience of the Eighth Army Ordnance Section where it was realized that the above factors required the establishment of facilities for training mechanics and maintenancemen to do a better job on Ordnance equipment.

Available to the Eighth Army Ordnance Officer, Col. W. M. P. Northcross, were the services of civilian engineers and technicians who worked for various manufacturers of Ordnance vehicles and who had volunteered for Korea in order to assist in setting up an adequate maintenance organization.

Private Reynolds is attached to the headquarters of the Eighth Army in Korea.

Complementing these men were a group of Ordnance officers and men from the Ordnance Tank Automotive Center in Detroit who were already in Korea to assist in establishing courses of instruction on certain vehicles.

Colonel Northcross, with the assistance of these men and officers of Eighth Army Ordnance and of the 59th and 60th Groups, planned classes and lesson plans, selected equipment and instructors, and obtained authorization for establishment of the school.

Roll call for the first class was held February 7, 1953. Since then other classes have been added, while courses taught at outlying units were integrated into the program of the school. A total of eleven classes are now being instructed and others will be added when the occasion arises.

Student allotments are distributed throughout the corps and divisions and hence to the companies that might need men trained in that field.

Two basic requirements must be met by a soldier before he is considered for the school: (1) He must have at least six months' retention in Korea and (2) be currently performing duties in his unit that pertain to the course he will follow in the Ordnance school.

Classes which are offered at the school range from an instructor-inspector course to training on the new medium tanks in Korea. The instructor-inspector course is intended to train key Ordnance noncommissioned officers in the techniques of tactfully instructing men on the job and in the field.

"Cannon evaluation" is the most unique schooling offered. It is the only class of this type given in the world and enables students to evaluate artillery tubes so they may estimate the "life" that remains in the bore of an artillery piece.

"THIS type of training was instituted," explained Col. William A. Davis, commander of the 59th Ordnance Group, "because in this war, more than any other war, the artillery played an important part. It wasn't unusual to find a howitzer, or rifle, firing for hours at a time, day after day. Such continuous use puts unusual stress on the tubes and causes them to approach a dangerous point much sooner than normal.

"Instead of scrapping the entire weapon when it reaches this critical point, the expert on cannon evaluation can tell when it will crack and the tube can be replaced by a new one."

Representatives of Continental Motors, Reo Motor Company, and the

Allison and Cadillac Divisions of General Motors assist in preparation of the programs of concentrated instruction on the vehicles and components built by their respective companies.

To get a capable man to command the school was a problem that was successfully solved when Lieut. Col. M. A. Kinley, Dallas, Tex., was named commandant of the Ordnance School. Colonel Kinley's background consists of a master's degree in mechanical engineering from Carnegie Tech and graduate work toward a doctorate at the University of Michigan.

Before his integration into the Regular Army he was an automotive consulting engineer for the Ethyl Corporation and prior to that was a design and development engineer for General Motors.

The school has an authorized strength of seven officers and ninety enlisted men who serve as instructors and cadre. Some students come from the Air Force and many of the United Nations to participate in the training at the school.

WITH its rigorous training schedules and long hours of study, the school is renowned as an advanced training center. However, students who attend the school are free from other duties, thus providing them an opportunity for rest and relaxation. This, and the fact that promotions go with more specialized training make the school one of the most popular units in Korea.

The school is under the direct command of the Eighth Army Ordnance Officer, Colonel Northcross, who dictates the policy, and is attached to the 59th Ordnance Group for technical and administrative supervision.

Success of the school is very evident by the performance of the men who have already graduated and have applied their newly learned knowledge to practical situations. The secondary success may be picked out of the evaluation slips that the students fill out and submit, unsigned, on the completion of their course for they have been unanimous in their praise of the school and its accompanying facilities.

By the employment of such schools the men who maintain the fighting equipment of our Army learn to keep America's superior firepower ready and able to repel aggression.

Above, the power pack of an M46 tank is removed for spot checks. Below, students prepare equipment in the cannon evaluation class at the school (Army photo).

Below, a jeep chassis and motor are carefully studied by students in the wheeled vehicle course at the Eighth Army Ordnance School in Korea (Army photo).

Cold Extrusion

The forming of metal in presses without heating, machining, grinding, or welding has many possible useful applications for the successful manufacture of critical military components

George E. Whitlock

TO the ordnance specialist, always on the lookout for better and less-expensive ways to produce parts, the cold extrusion of steel offers many opportunities, but it also requires him to change some of his previous concepts of production methods. To his knowledge of machining, forging, stamping, casting, and fabricating he must now add facts pertinent to a process that makes parts to final dimensions on presses without machining, without grinding, without welding or heat treating.

To date the Mullins Manufacturing Corporation has produced more than 6 million extruded 105-mm. shells, 81-mm. mortar shell bodies, 2.75-inch rocket heads, and 3-inch Navy shells at its Liberty plant in Warren, Ohio. This facility, equipped by Army and Navy Ordnance with five press lines and all the necessary supporting equipment, uses steel bar stock as its raw material.

SLUGS of steel are cut to within a few ounces of the weight of the finished shell and then are shaped cold. Other equipment required includes Bonderizers to prepare the surface of the metal for fabrication, salt pots or induction heating furnaces for stress relief or anneal, machines for cutting threads and band grooves and for facing off the ends, and of course, painting and packaging facilities.

Cold extrusion saves metal and alloys. In the production of a 105-mm. shell there is a loss of only two pounds of metal; in an 81-mm. mortar shell, only nine ounces. This compares with ten to fifteen pounds of metal lost when 105-mm. shells are made by other methods.

Mr. Whitlock is president of the Mullins Manfacturing Corporation, Salem, Ohio.

Our total metal loss from forming and machining should not be higher than four per cent. *All* loss, including that from saw cuts, plus that produced by forming and machining, should not exceed ten per cent of the total metal purchased.

In other methods of shell production, metal loss amounts up to forty per cent of the total metal purchased. In wartime, this saving of 4,000 to 6,500 tons of steel per million 105-mm. shells is of vital importance.

As for quality of product, extruded shells offer many advantages. An extruded projectile is glass-smooth outside, with no machine marks to affect its flight, thus providing greater accuracy. Its surface measures 50 microinches or better against a Government specification of a 250- to 500-microinch finish.

The cavity of an extruded shell is smooth. Weight control is so accurate that only one loading zone is necessary. A 105-mm. shell, for example, is held within a weight tolerance of plus or minus two ounces, and the 81-mm. to plus or minus one-half ounce. Fragmentation is the same as with a heat-treated shell.

The largest tonnage, or pressure required to produce the 105-mm. shell is only 1,050 tons. Early steel-extrusion efforts in Europe employed mechanical presses and erroneously gave the impression that only mechanical presses of high tonnage were capable of extruding steel.

Both our plants, the Liberty ordnance shop and the new commercial facility at Warren, are equipped with hydraulic presses throughout. The largest press at Liberty is 1,500 tons, while the largest press at the commercial Koldflo shop is 3,000 tons.

THE Koldflo process did not spring full-blown from our drawing boards. Years of work and hundreds of thousands of dollars have been expended, and we have not yet finished.

We first became interested in the possibilities of steel extrusion during World War II when we were hot-forging 105-mm. shells. Our early experiments included hot-forging a steel cartridge case and then finishing it cold by drawing.

After the war we continued experimenting and produced some pieces by extrusion—enough to indicate the potentialities of the process.

In May 1947, the Cleveland Ordnance District offered us a contract to develop a manufacturing procedure to make a new shell. By mid-August 1947, we shipped our first shells for testing. After this initial success, we developed

other cold-extruded shells for Ordnance. When the Korean campaign began, we were ready to convert our Liberty plant to shell production.

On paper, cold extrusion of steel is simple—squeeze metal within a die and force it to take the shape of the die. Actually, it is not as easy as that.

As we developed our knowledge of the behavior of steel under pressure, we did so recognizing that extruded steel parts would not be practical unless they could be made on a mass-production basis from low-cost carbon steel on hydraulic presses.

To meet these requirements, unique die designs and precise operating techniques were developed.

Even the most experienced designers and engineers find that cold extrusion excites their imaginations. When one studies an extruded shell, with its perfectly formed bourrelets and then looks at the slug of metal from which it was made, it is excusable if one wants first to be *shown* before he believes that it was done without the use of machine tools or heat.

COLD extrusion of steel should be studied with an open mind. Steel is not the unyielding material the layman thinks it is. Properly handled it is highly plastic, and the reduction in 1010 and 1012 steel can be as high as eighty-five per cent.

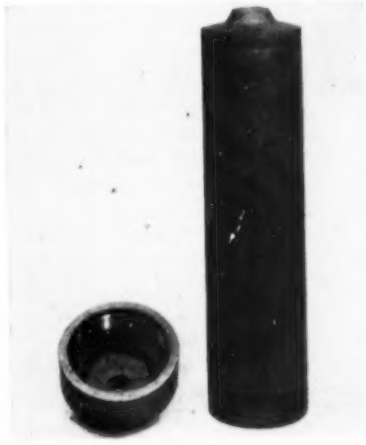
When one departs from the relatively simple shape of a shell, many of the potentials of the extrusion process become apparent. Consider a rocket. The process can make the war head and motor body from one piece of metal—without expensive machining, without welding or screwing parts together.

The art, of course, is to extrude from both ends of the round slug of metal, forming the war head out of one end, the motor body out of the other, and leaving a partition of metal in the middle. The partition must be nonporous, and we have developed a technique for interlocking the grain of the metal at this point to provide a completely leakproof shield.

As indicated by the rocket, cold extrusion is not limited to heavy-walled cylinders. Walls as thin as 0.060-inch can be formed in cylinders with an outside diameter of 5 inches. And variable wall thicknesses can be precisely controlled, a feature not usually found in deep drawing. Extrusion enables us to vary the thickness, providing extra strength where needed.

Above, three stages in cold extrusion of 105-mm. shell. Below, cutaway view of shell produced by Koldflo process.

Below, close tolerance pressure cylinder produced by cold extrusion presses.



Because of the precise nature of cold extrusion, the manufacturer must work with rigidly controlled techniques. Each piece is finished in the die, with no opportunity to correct errors by machining. The dies must be made exactly right, and the slug must be cut to exact length.

Much has been written about lubrication processes for cold extrusion. It is more complicated than lubricating for stamping or deep drawing, but no amount of lubrication can offset improper die design or poor operating procedure.

The Mullins process uses a standard phosphate coating as a host for lubricant. With it we find that the lubrication phase of extrusion reduces itself to a routine operation.

The selection of proper steels and their availability is of real importance to the designer or manufacturer of extruded parts.

All shell production at our Liberty Plant has been confined to two grades of steel—AISI 1010 and 1025. The first grade is used in 5-inch rounds, supplied in the hot-rolled condition.

The chemistry is covered by specification MIL S-11301A and is identical to AISI 1010 except that mills supply this grade to a 0.10 per cent maximum Si and to a McQuaid-Ehn grain size of 5 ASTM or finer.

The silicon is held low because higher silicon contents result in excessive work-hardening. The steel is fully killed and hot-topped, and the resulting fine grain insures better mechanical properties and precludes stringer type inclusions usually found in silicon killed grades.

MOST of the 1010 heats worked at Liberty show chemistry ranges on the high side for carbon and manganese. It has been proved that high sulphur produces excessive cracking. Although 0.030S is acceptable, 0.050S and over cannot be extruded as successfully. The lower the sulphur, the better, and this includes phosphorus.

Alloy residuals are harmful to good steel performance. For best operation the residuals of chromium, nickel, copper, and molybdenum should not exceed 0.20 per cent.

Originally the 5-inch bars were ordered annealed from the mills. This is no longer necessary as the bars are soft enough in the hot-rolled condition.

Surface defects such as seams, laps, slivers, etc., are the chief deterrents to an acceptable end product. All bars are produced to "shell quality," but if there are laps or other surface defects in the finished bar they require conditioning after the first extrusion. A grinding operation should be provided to take out seams that were missed by the mill.

The macro-etch quality and cleanliness on cold-extruded shells is covered by the specification MIL M-11266. Usually ingotism or pattern is not troublesome, as long as pipe or massive segregation is not encountered.

MECHANICAL minimum properties of 65,000 pounds per square inch yield strength on the 105-mm. shell made from 1010 are easily met. This and the minimum fifteen per cent elongation in two inches are carry-overs from hot-forged shell specifications.

Cold-extruded shells could be produced to an 85,000 to 90,000 yield strength if the elongation were dropped to 12 per cent.

The next largest steel requirement at Liberty covers AISI 1025 which is used to produce a 3-inch Navy shell. Again the chemistry is standard except for the 0.10 maximum Si and specified grain size. Also the residuals should be kept low.

The bar size for this shell is 3½ inches, and it is purchased annealed and machine-straightened to a hardness of Rb. 60 to 65.

Considerably less reduction is used to make this shell than the 105-mm. However this carbon range always shows more defects than associated with 1010 so that steel requirements are just as severe.

This shell must meet a minimum 78,000-pound-per-square-inch proof stress which actually means elastic limit. On this shell, also, a minimum of 90,000 per square inch ultimate strength is required on the base.

Other types of carbon steels have been tested, but all are not suitable for mass production of quality shells at a minimum price. Capped, rimmed, and semikilled AISI 1012 steels show too many internal defects and contain nonuniformities in segregation and soundness.

Alloy steels lend themselves to cold extrusion in a limited way. Alloys work-harden faster, requiring more annealing. Another detriment to using alloy is that the base hardness is so high that the range from base hardness to the maximum hardness at which these alloys can be worked is excessively narrow.

Good punch life at Liberty varies between 50,000 and 200,000 pieces before redressing, depending upon the size of the shell. By using carbide, the piece rate can be greatly increased, but such punches cost considerably more.

One of the biggest contributors to good punch or die life is cleanliness. If this factor is poor, tool life will be poor without exception.

One punch, used under experimental conditions, ran 500,000 pieces without being redressed. We have broken tungsten carbide punches when an operator put two pieces in a die, but we have never worn one out.

A GOOD question to ask at this phase of study of the cold-extrusion process is, "When should extrusion be used and when not?"

First, it must be remembered that this is a mass-production process. It is not intended for runs of a few hundred or a few thousand.

The original cost of dies is an important factor, and there are many items for which manufacturers are already tooled that could not be economically converted to cold extrusion because subsequent production runs would not be large enough to justify the tool expense.

On the other hand, the advantages of cold extrusion are many, and the parts produced by it are often superior to those made by forging or machining. Designers will therefore pass quickly from converting existing parts to the new process to the creation of original designs.

An example of this can be found in the hydraulic-cylinder industry. Cylinders have been made for years from seamless tubing with cast or machined ends bolted or welded into place. There were no standards for the industry, because a standardized production method had never been developed.

The Koldflo process offered such a method when it was demonstrated that a cylinder with one closed end could be produced with an extremely close inside tolerance and with no taper. Furthermore, the interior surface has the same sealing characteristics as a finely honed surface.

In addition, many of the fastening lugs and the inner blocks and stops which previously had been made by machining or welding could be extruded at the same time as the cylinder.

In brief, the four major features of cold extension are: (1) large steel savings, (2) good surface finish, (3) accurate size, and (4) superior final mechanical properties—all obtained from a single process.

THE cold-extrusion process, with its great potential savings in raw materials, is of increasing importance today in view of the following facts from the report of the President's Materials Policy Commission:

"In 1950 we were taking from the earth (among other things) 3½ times more iron ore than in 1900. . . The quantity of most metals and minerals used in the United States since the First World War exceeds the total used throughout the entire world in all history preceding 1914.

"This vast drain upon resources that cannot be renewed, greater today than yesterday, and inescapably greater tomorrow than today, has become the most challenging aspect of our present-day economy. A ton of ore removed from the earth is a ton gone forever.

"The time has clearly passed when we can afford the luxury of viewing our resources as unlimited and hence taking them for granted. In the United States the supplies of the evident, the cheap, the accessible, are running out."

Some measure of the progress of American extrusion methods can be obtained from the fact that in December 1953, Hans Fischer, credited by many with being the father of cold extrusion of steel, visited the Mullins Manufacturing Corporation to obtain a license to use the Koldflo process.

Mr. Fischer is a director of Kabel und Metallwerke, Neumeyer of Nuremberg, Germany. The license gives his firm the use of the Koldflo process in Western European countries.

Ultrasonic Machining

A new process using soundless, high-speed vibrations makes it possible for unskilled labor to machine hard, brittle metals and nonmetals to close tolerances rapidly and safely

Dr. Lewis Balamuth

"UNMACHINABLE" metals and nonmetals can now be ground, lapped, cut, drilled, embossed, or otherwise machined into simple or intricate shapes by unskilled labor. This is done by an ultrasonically vibrating soft-steel tool pressed gently against the work while a mixture of abrasive particles and water is flowed continuously into the working area.

The working stroke of the tool is so small it cannot be seen with the naked eye. More than a million blows per minute rain on the work so that the vibrations make no sound.

The startling effect produced is the sight of an apparently motionless tool of complex shape quietly sinking into a piece of tungsten carbide to the accompaniment of a gentle hissing noise produced in the water-abrasive slurry.

More than ten years of continuous development have gone into the new ultrasonic machine tool, which was designed by the Cavitron Equipment Corporation of Long Island City, N. Y. However, according to a recent announcement, the Sheffield Corporation of Dayton, Ohio, will henceforth design and market Cavitron machine tools.

This tool employs ordinary commercially available abrasives manufactured in the United States. The potential significance of this may well be appreciated from the fact that conventional methods of grinding and forming hard, brittle, "unmachinable" materials accounts for the consumption of most of the critically needed diamond bort imported from abroad.

Dr. Balamuth is the inventor of the Cavitron process of ultrasonic machining. At present, he is serving as physics research consultant to the Cavitron Equipment Corporation, Long Island City, N. Y.

This applies, for example, to such vital production operations as the sharpening of single-point carbide tools, the grinding of chip breakers, the making of carbide form tools, the production of carbide dies of all types, and the grinding and forming of turbine jet bucket blades.

The Cavitron process readily machines conducting, semiconducting, and nonconducting materials. The new character of the technique is highlighted in that the less ductile a substance is the more easily is it cut. This is quite the reverse of experience with ordinary lathe turning, milling, and drilling operations.

Thus, copper, brass, and mild steel will fare poorly in the ultrasonic method, while metals like hardened tool steel, tungsten carbide, and boron carbide do well.

TO the last-named metals may be added metals and semimetals such as titanium carbide, zirconium boride, stellite, osmium, germanium, Alnico, and silicon carbide.

Among the nonmetallic, nonplastic substances which are ultrasonically machinable may be numbered diamond, rutile, sapphire, fuzed quartz, crystal quartz, glass, ceramics, ferrites, and sintered aluminum oxide.

The experience with plastics has been more limited since most of the successfully used commercial plastic parts are formed by molding techniques to suitable tolerances. Nevertheless many plastics tested have been found to be machinable, especially those having brittle characteristics.

THE above list, although partial at best, serves to indicate the wide variety of fields in which ultrasonic machining can perform a useful service. It ranges from the fabrication of coining, blanking, heading, and drawing dies to the forming of miniature circuit components, subminiature electronic components like germanium diodes and transistor blanks, ferrite inductors, crystal oscillators, ceramic tube element parts, jewel bearing blanks, and carved gem stones.

Rough grinding is normally carried out with an accuracy of 0.002-inch, using 280-grit boron carbide as the abrasive. In the case of softer materials such as glass, quartz, germanium, and many ceramics and plastics, cheaper abrasives like silicon carbide and aluminum oxide are suitable.

The as-cut finish on hard materials runs about 25 microinches rms. However, greater precision and finer finishes are achieved merely by employing finer grit sizes for the abrasive. Polished surfaces are attainable with boron-carbide in the range from 1,600 to 2,200-grit.

The rate of cutting depends on the material being worked, the area over which the grinding occurs, and the power input to the cutting head. Several examples will best illustrate production rates in different types of operations.

Using a soft-steel 6 fluted spline, a ⅛-inch-thick carbide drawing die was made in 3 minutes. In another case, axial serrations 0.031-inch deep were put in a carbide knurling roll ¾ inch in diameter by ⅜-inch long in 26 minutes. The tool was a simple soft-steel sleeve with matching serrations in the bore. Previous time for this job by conventional methods was thirty hours.

IN general, the fabrication of hardened steel and carbide dies by the new process has shown time savings anywhere from twofold to fiftyfold, depending on the job.

Whether the tool used is composed of one or many elements makes no difference. This is inherent in the stationary reciprocating character of the method. One manufacturer came up with the problem of making a special ceramic spacer element for an electron tube. The spacer required six small holes precisely located around the perimeter of a rectangular hole in the center of the element.

The answer was easily found by jig-drilling six holes in a hexagonal mild-steel plate provided with a projecting rectangular stud to locate the center hole of the spacer. Steel pins of the proper diameter were brazed in position in the holes in the plate and then the assembly was screwed onto a tool holder.

A hundred or more of the spacer blanks were then cemented to a glass plate and one complete spacer was machined at a time. The production time per spacer was under thirty seconds.

Gang sawing or slicing of hard materials into thin wafers is a problem found in diverse industrial fields. The production of thin wafers of germanium, sapphire, and quartz are necessary, respectively, in the making of transistors, jewel bearings, and crystal oscillators.

By wielding or brazing a parallel array of thin steel or molybdenum blades spaced at the desired distance a gang cutter is made. Wafers of the above-mentioned substances, 0.015-inch in

Above, the ultrasonic machine transducer with toolholder attached. Below, cuts made in tungsten carbide by ultrasonic method.

thickness, have been ultrasonically machined with such cutters. Also the blades used were thinner than those found in conventional diamond-saw gang cutters. The surface sawed by this cutter is free from saw marks and gives the appearance of having been lapped.

Germanium, sapphire, and quartz are valuable in just that order. A new method which forms them into desired end products with a minimum waste of raw material is important. It adds up to needed conservation of our national resources.

Similar considerations apply to the dicing of germanium wafers into transistor blanks as well as to the blanking of sapphire wafers into jewel-bearing blanks or rondels.

Transistor blanks are generally in the form of minute squares of from 0.040-inch to 0.060-inch on an edge. Steel strips 0.005-inch thick may be interleaved in the manner of an egg crate and brazed together to form a square grid tool with one hundred square openings.

When attached to a toolholder, this tool can produce up to one hundred transistor blanks every six to eight seconds.

By far the greatest amount of diamond bort is consumed in American industry in grinding chip breakers in carbide tools and in sharpening carbide tools of all sorts. Soft steel and boron carbide abrasive have been used successfully in the offhand grinding of carbide tools as well as in the grinding of chip breakers.

The standard Model 500-C Cavitron machine is not well adapted to this application for production purposes. The problem however lies in developing the proper combination of the machine's parts rather than in the efficacy of the process itself. For example, it has been established experimentally that chip breakers may be ground ultrasonically in from thirty seconds to two minutes.

Carbide form tools play an important rôle in modern machining. Ultrasonic manufacture of many complex form tools involves simply a thin soft-steel plate bent to the desired shape. This bent plate, used as a tool, is sunk edgewise into a carbide blank. In this way a male and a female form are produced in one operation.

A flat form tool of intricate contour was thus made in fourteen minutes. The dimensions of the form were held to 0.0005-inch. Diamond wheels and conventional techniques took seven hours for this job.

A SUFFICIENT number of instances have been advanced to indicate the scope and versatility of the ultrasonic method for machining. Let us now turn briefly to the actual process.

The process consists essentially of vibrating a soft-steel tool at high frequency and with a minute working stroke. At the same time the work to be machined is held with moderate pressure against the tool while a slurry of abrasive particles and water is flowed continuously into the work area.

The tool appears to be stationary while cutting because the working stroke is only a few thousandths of an inch. The vibrations are soundless because the operating frequency is ultrasonic (from sixteen to thirty thousand times a second).

The only sound to be heard while machining is a gentle hissing noise produced by the continuous collapsing of the thousands of cavitational bubbles formed in the water by the intense vibrations.

Perhaps the simplest way to grasp the idea of how the cutting is performed is to think of the tool as a hammer, the workpiece as an anvil, and the thousands of abrasive grains between the two as so many chisels. On each downstroke of the hammer the hard, tiny chisels are driven with great force into the anvil, chipping out microscopic particles of the work.

The fact that this is repeated many thousand times a second makes for a smooth, continuous sinking of the tool into the workpiece.

Strange as it may seem, the end of the tool never travels very fast. In fact, at the fastest point of its stroke it scarcely attains twenty miles an hour. On the other hand, the acceleration induced in the end of the tool by the high frequency of the vibration can be fantastically high.

FOR example, a tool with a working stroke of two thousandths of an inch and operating at thirty thousand strokes a second will achieve a peak acceleration of nearly one hundred thousand times the acceleration due to gravity! Hence it is not too far-fetched to think of the tool's behavior as no motion and all acceleration.

A standard model 500-C machine consists of three main parts. First there is an electronic generator, mounted on casters for mobility, which provides 500 watts of variable-frequency alternating current to the vibrator head. Secondly comes the vibrator head which houses a water-cooled laminated magnetostrictive transducer composed of nickel laminations.

The transducer converts the electric power into intense mechanical vibrations which are conveyed to a monel toolholder. The toolholder acts as the ultrasonic hammer to which a soft metal tool is either brazed or screwed.

Finally the vibrator head is mounted in a specially designed ball-bearing vertical motion, and is restrained from falling by means of a counterweight. This motion permits the tool to sink along a precisely vertical axis into the work.

The pressure between the work and the tool is controlled merely by adding or subtracting weights in the head. The depth and rate of penetration may be observed by watching a dial gauge fastened to the motion.

MODEL 500-C units may be installed in less than twenty square feet of floor space. The motion is held in a quick-adjusting sturdy universal mounting to permit rapid location of the tool. The work is mounted in a specially designed chuck provided with calibrated cross slides and a means for rotating it to any angle about a vertical axis.

The abrasive slurry is fed to the work clamped in the chuck by means of a simple bronze-vaned impeller pump through two flexible hoses which are attached to the worktable.

The toolholders used for ultrasonic machining serve other purposes than holding the tool in position. In the first place it must be an efficient transmission line for the ultrasonic vibrations which are conveyed from the transducer to the tool through it.

Secondly, it must have high tensile strength to assure long dependable life without fatigue fracture. These two conditions are well met by wrought monel which has very good acoustical qualities.

In addition, the toolholder must be designed as a mechanical impedance transformer so that the very minute vibrations of the transducer are magnified and properly transferred to the tool.

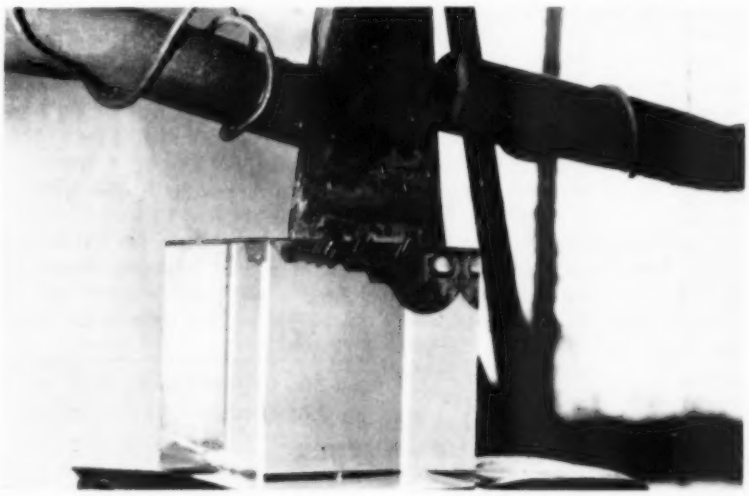
This problem is solved by the proper shaping of the toolholder together with the adjustment of its output area to accommodate the tool.

As has been seen, the tools used are generally mild steel and are inexpensive. They are easily attached to the toolholder either by brazing or screwing. When hollow tools are used as is the case in blanking, dicing, and gang sawing, the toolholder is provided with one or more internal holes to permit an internal flow of abrasive slurry.

Low stress and absence of local heating characterize the process. Work surfaces as machined are consequently free from pitting, thermal cracking, or burnt color. No chemical change or alteration of physical properties, such as hardness, is produced. Above all, the process is one of the safest yet devised. Since it is a stationary device with no exposed electrical or moving parts, chips, or shavings, it can be operated by an unskilled worker with a nominal break-in time.

Engineers are constantly working to adapt the process to new applications. There is no doubt that many new uses will be discovered, and that greater efficiencies will be reached.

Close-up view of the ultrasonic machine sinking a house key into a 2-inch-square glass block. Abrasive flows from tubes on either side of tool.



Chemical Weed Control

Recently developed compounds now make it possible to keep military and industrial installations free of weeds and brush with a minimum expenditure of valuable time and manpower

William Gaylord

SECURITY and fire safety around all types of military installations are so important that no detail should be overlooked, particularly where critical or highly inflammable matériel is manufactured or stored.

Controlling vegetation is recognized as an important aspect of matériel protection, but current high labor costs and stringent economy measures have made it increasingly difficult to commit large numbers of men to the seasonal job of weed control.

In many areas where the problem is most severe, hand cutting or even mechanical mowing is not adequate. Frequently it is desirable to keep the ground completely bare of vegetation —not only around magazines and igloos, but in warehouse areas, along railroad tracks, road shoulders, and fence lines.

IN such areas, weeds and grasses not only increase the fire hazard, but they may interfere with workmen and with security patrols. At Picatinny Arsenal in Dover, N. J., for example, the perimeter security fence runs through an uncleared area of woods and brush, where the natural cover of vines and grass tends to grow up to the fence and tangle through it. This presents a serious security problem, and the close-growing vegetation may hold enough moisture to rust the fence.

Thick vegetation may obscure part of the fence itself, and might even provide sufficient cover to hide a man or to conceal accidental or deliberate breaks in the fence. Lacking a clear line of sight down both sides of the fence line, guards in cars along the perimeter control road have to stop and "beat the bushes."

In contrast, fence lines where vegetation has been eliminated are clearly visible for the whole height and length, so guards in a slow-moving patrol car can see every strand of wire and observe the ground on both sides.

Like a good many other military installations, Picatinny has tackled the weed-control job with chemicals. The use of chemicals for weed control is not new. But it is only since World War II that compounds have been developed with enough safety factors and other advantages to favor their use on a large scale around military installations.

The Picatinny post engineer's office was seeking a chemical weed control that could be used safely and economically around the arsenal to "kill everything." The Du Pont Company believes that CMU weed killer, which came on the market late in 1951, provides the answer.

Other compounds for specific uses had been tried previously. Some were ideal to kill brush where it was desirable to let grass come in for erosion control. Others were intended to kill broad-leaved weeds in turf.

The first CMU test plots at Picatinny Arsenal were sprayed in June 1951, and control was still so satisfactory in the summer of 1953 that no respraying seemed necessary. The Du Pont Company, manufacturers of CMU, sent a technical service man to help Picatinny personnel set up the original test plots.

To establish accurately measured plots under practical conditions, they chose a road shoulder where light poles were evenly spaced, about 125 feet apart.

THE weed-covered area between each pair of poles from the pavement to a parallel fence line measured a tenth of an acre, so it was easy enough to apply the chemical at specific experimental rates of 20, 30, 40, and 60 pounds per acre.

Results on these test plots were so good that more spraying was undertaken in 1952, and Picatinny now looks toward chemical control everywhere on the post where applicable. This includes a sprayed swath about 15 feet wide along the perimeter fence from the patrol road to 5 feet outside, 55 miles of railroad track, and 48 miles of road shoulders.

In addition, there is the 50-foot safety area around each igloo and magazine where a nonflammable long-lasting chemical weed killer can save many hours of work each season.

Up to now, these were places where men with hand mowers, sickles, and

Mr. Gaylord is a technical representative with the E. I. du Pont de Nemours Company, Wilmington, Del.

clippers spent many hot summer working days trimming around poles, fence posts, curbings, etc., where power mowers can't go. Along the rail lines, weeds and grasses interfere with signals, switches, and maintenance crews, besides causing a fire hazard, an eyesore, and a harborage for snakes and rodents.

Another installation that has had outstanding success with chemical weed control is the Naval Ammunition Depot at Earle, N. J. A total of 126 miles of railroad at the depot was sprayed last May with virtually 100 per cent control of weeds and grass. Where the rail spurs run through the explosives-storage areas, this program has eliminated a serious fire hazard. A major brush-control program along fence lines and roadsides also has been undertaken, using chemical weed and brush killers.

At the New Orleans Port of Embarkation, which includes about eight separate installations, the chemical spray has been used with considerable success under fences, around buildings, on roadways and other places inaccessible to mechanical mowing. Delta Shipyards, the Army Ammunition Dump at Slidell, La., and Camp Leroy Johnson have all been included in the extensive chemical weed-control program.

Air Force bases also find considerable use for chemical weed control. At Fairchild Air Force Base in Spokane, for example, weeds have been a serious problem along the railroad line, perimeter fence, gasoline storage areas, fire hydrants, and landing lights. CMU has been applied to these areas with great success.

CMU comes as a wettable powder which is mixed with water for spraying. Picatinny's experience with application methods serves as a good example of its use.

A SPRAYER truck was used that was put together in the post's heavy-equipment shop. The basic unit is a 10-wheel, 6 by 6, 2½-ton truck with a steel stake body. Almost any truck with equivalent power and capacity could be used. The 6-wheel drive provides extra power where it is necessary to drive over rough terrain.

On the truck is mounted a 350-gallon tank and a 2-horsepower motor which drives a pump delivering four gallons a minute at 400 pounds' pressure. Two hundred feet of hose lead from the pump to an adjustable-nozzle hand gun. Continuous agitation is provided to keep the CMU in suspension in the spray tank, which is very important. Forty pounds of CMU in the full tank usually takes care of half a day's spraying.

This equipment is operated by a 2-man crew, working under the supervision of the chief of the Buildings and Roads Branch of the Engineering Division. The two men carry a pay-roll classification of labor supervisor and labor leader, respectively. They and their chief learned the principles and techniques of chemical weed and brush control at the Insect and Rodent Control School conducted by the First Army at Fort Dix.

With this training and three seasons' experience, the crew has become quite expert in applying chemical weed sprays. Usually one man stays at the wheel of the truck, while the other handles the spray gun.

Since hydrants and other water points are well distributed all over the post, refill stops cause a minimum of delay. If water were not readily available, it might be desirable to have a larger tank or an auxiliary tank mounted on the truck or pulled on a trailer. Since each filling takes only forty pounds of the chemical, drums for the refill take up very little space.

This space factor is important in considering storage of the chemicals—since a whole season's supply for Picatinny (80 pounds a day for 180 days) would be only a little over 7 tons.

For railroad application the truck can be driven up a ramp onto a flat-car and anchored in place. Then a yard engine can move the sprayer over all the track to be sprayed.

With long-lasting chemical weed control such as Picatinny is achieving, it seems possible to map out a rotation program to cover all "sprayable" areas on the post with the 2-man crew and sprayer, finishing the final area before the first-sprayed area has become a problem again.

FOR others who are interested in the manpower and money economies that can be achieved through chemical weed control, a number of suggestions have been made.

First of all, chemical weed killers are specialists, and the right one must be picked for the right job. Selective weed killers will not clear the ground. On the other hand, with CMU to "kill everything," it was found that even shade trees some distance away might be affected if any feeder roots extended into the sprayed area.

It is advisable to enlist technical advice from the manufacturer, at least for initial experimental applications, in order to get best results with the chemical and become familiar with the safety factors involved.

Patience is also advised. CMU works through the roots of plants, not through the leaves. The speed with which it takes effect at various dosages depends on rainfall, soil type, and soil moisture. Deep-rooted weeds may survive longer than shallow-rooted grasses. But where there has been enough rainfall to carry the chemical into the soil, most species will show signs of its effects within a few weeks. The first sign is yellowing and "burning" at the tips of leaves. Then the leaf margins turn brown, and finally the whole plant dies.

INCIDENTALLY, this compound can be applied in fall or early spring so that it will be in the soil to prevent plant growth at the beginning of the season. CMU does not kill seeds, but after the seed has sprouted the chemical goes to work on the seedling, killing it before it has grown much. This is especially valuable in keeping vegetation from becoming a fire hazard.

As for costs, the Picatinny experiment indicates that a 2-man crew ultimately may be able to do the job formerly requiring many times that number. Two men per season can be committed to the job of weed and brush control where a much larger staff would be occupied for six or seven months each year.

The difference in wages alone can be substantial—to say nothing of the cost of keeping tools in shape and maintaining a large crew for work that can be done only in fair weather during a few months of the year.

Figures from other installations show the same kind of economy in money and manpower—with increased efficiency in maintaining safety and security.

Automobile frame siderails are riveted to 3 sturdy crossmembers at this point in one of the production lines at Midland's Detroit Frame Plant. The assembly is then automatically moved on for final welding.

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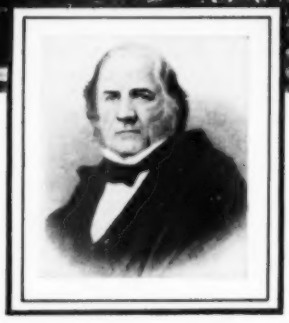

Cavalcade of American Hunters

When asked why he left clerking to live with the Indians, young Sam Houston countered: "I prefer measuring deer tracks to tape." He loved the sport of hunting, and this urge never left him. Even in later years, he'd often be seen setting out for deer, bear or antelope.

Red-blooded Sam Houston is best remembered for leading the Texans to victory and independence . . . or, perhaps, as first president of the Lone Star Republic. Yet, though his hunting exploits have been partly obscured, many have been handed down. Phrased in classic homespun, these accounts faithfully portray Houston the hunter—a sturdy plainsman who enjoyed every obstacle, thrill and satisfaction of this rugged sport.

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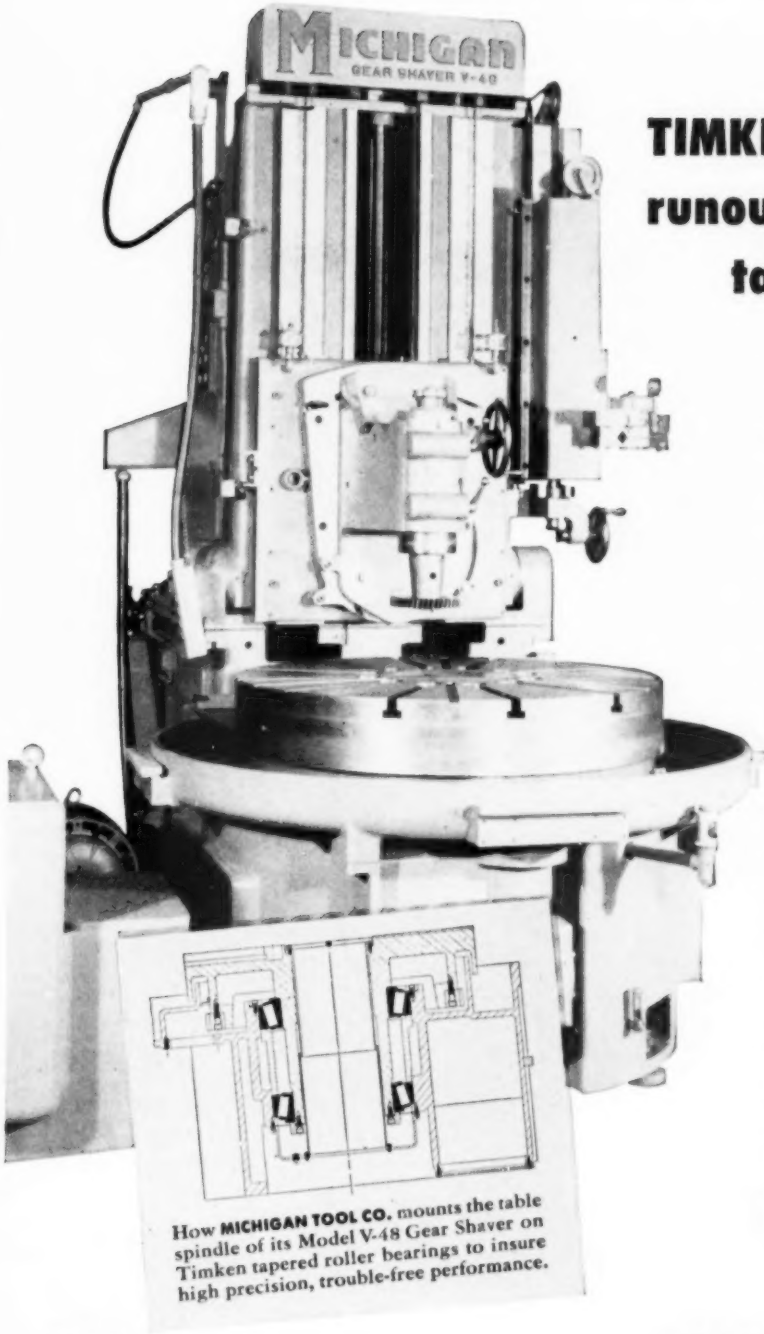

How **MICHIGAN TOOL CO.** mounts the table spindle of its Model V-48 Gear Shaver on Timken tapered roller bearings to insure high precision, trouble-free performance.

TIMKEN® bearings hold runout on gear shaver table to .0002"

TO maintain the high precision necessary in gear shaving operations, Michigan Tool Co. mounted the table spindle of its Model V-48 Gear Shaver on Timken® precision tapered roller bearings. At General Electric's turbine plant in Lynn, Massachusetts, a measurement of the gear shaver's accuracy showed a maximum runout of .0002", exceptional in view of the fact that the bearings involved have 17⅜" and 16⅛" bores.

Made specifically for spindle applications, these Timken bearings assure highest precision because of (1) bearing accuracy and (2) shaft rigidity maintained by line contact between rollers and races. And the tapered construction of Timken bearings eliminates end-play by taking any combination of radial and thrust loads. Result: gears are shaved more accurately.

True rolling motion and smooth surface finish make Timken bearings practically friction-free. Made of Timken fine alloy steel, Timken bearings normally last the life of the machine in which they're used.

Be sure to specify Timken bearings in the machinery you build or buy. Look for the trade-mark "Timken" stamped on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

FINISHED TO CLOSER TOLERANCES

Finishing to incredible smoothness accounts for much of the precise, smooth rolling performance of Timken bearings. This honing operation is typical of the amazingly accurate manufacturing methods at the Timken Company.

The Timken Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

NOT JUST A BALL ○ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ⓪ AND THRUST →⓪← LOADS OR ANY COMBINATION →⓪←

Buttoned-up and navigating blind

Operating tanks with full effectiveness in featureless arctic or desert terrain presents a new problem in "blind" navigation.

Dead reckoning and navigating under such conditions requires electronic and electro-mechanical systems that are highly complex yet simple to operate and maintain.

This growing field of vehicular navigation is another place where Arma is a leader in basic research, design, development and production. Over 34 years of close cooperation with the Armed Forces—and more recently the Atomic Energy Commission—stand behind Arma's reputation. *Arma Corporation, Brooklyn, N. Y.; Mineola, N. Y.; Subsidiary of American Bosch Corporation.*

ARMA ADVANCED ELECTRONICS FOR CONTROL

VOLUME XXXVIII, NO. 202 SECTION II JANUARY-FEBRUARY 1954

LAND SEA AIR ORDNANCE

THE ANNUAL DIRECTORY SECTION 1954

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Published by the

AMERICAN ORDNANCE ASSOCIATION

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AMERICAN ORDNANCE ASSOCIATION

Founded 1919

A patriotic, educational, scientific, nonpolitical, and nonprofit-making organization of American citizens dedicated to scientific and industrial preparedness for the common defense

ORDNANCE is the generic term embracing:

All weapons and appurtenances for their operation and maintenance.

All ammunition and its chemical, metallurgical, and atomic components.

All rockets, bombs, guided missiles, torpedoes, depth charges, and mines.

All combat vehicles, tanks, tank destroyers, and weapon carriers.

All vehicles for automotive transport of personnel and matériel on land.

All optical, aërial, mechanical, electrical, and electronic systems for locating and tracking targets on land, at sea, and in the air.

- The need for a civilian association of private citizens to coöperate with the ordnance organizations of our Armed Forces arises from the fact that, in the United States, in accordance with traditional national policy, there is little or no private industry for the production of ordnance in time of peace. Yet in time of emergency, as our experience in two world wars so tragically proved, ordnance of superior quality and in great quantities must be available in a very minimum of time for the use of our armed forces in order to avoid incurring unnecessary expenditures of hundreds of millions of dollars and, infinitely more important, the sacrifice of hundreds of thousands of American lives.

- Trained scientists and engineers in the laboratories and industrial establishments of our country, alert executives and key men of our factories and plants, students at our technical colleges, and artisans of our vast economy—all are united through membership in the American Ordnance Association in the firm determination to achieve peace through strength by providing superior ordnance for our Armed Forces.

- To keep alive a knowledge of ordnance design and production; to assist in the solution of the ramified technical, scientific, and economic problems incident to ordnance preparedness; to weld into an active, alert, and skilled group all eligible citizens for the advancement of scientific and industrial preparedness, and thus to contribute to the strength of our national security and the maintenance of peace—these are the goals of the American Ordnance Association, and to these ends its constitution and by-laws are directed. An organization chart of the Association is on pages 20 and 21.

American Ordnance Association

COUNCIL

The elective body of the Association is its Council composed of one member representing each local Post, one member representing each Technical Division, the three immediate past presidents, the charter national officers and directors, and twenty-four members at large.

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Posts of the Association are formed for the general purpose of cultivating a more intimate understanding of ordnance subjects through meetings, plant visits, seminars, and reports on particular ordnance problems.

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William A. Weaver, Griswold-Eshleman Company, Cleveland, Ohio.
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John Bergman, Vancouver, Wash.
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Theodore Emerson, Bonneville Power Administration, Portland, Oreg.
Paul L. Fowler, Fowler Manufacturing Company, Portland, Oreg.
Ralph H. Fulbright, Timber Structures, Inc., Portland, Oreg.
Edward Haas, Ballou & Wright, Portland, Oreg.

Empire Post, April 29, 1938

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Myron J. Hayes, Eastman Kodak Company, Rochester, N. Y.
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Thomas L. Lee, Rochester, N. Y.
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H. B. Sheets, Marine Trust Company, Buffalo, N. Y.
Keith Williams, Pratt & Letchworth Company, Buffalo, N. Y.

Frontier Chapter, Empire Post

Chairman: H. B. Sheets, Marine Trust Company, Buffalo, N. Y.
Membership Committee: Ray C. Neal, R. C. Neal Company, Buffalo, N. Y.

Steering Committee Chairman: Keith Williams, Pratt & Letchworth Company, Buffalo, N. Y.
Treasurer: Walter Schmidt, Niagara Mohawk Power & Light Company, Niagara Falls, N. Y.

Jamestown Chapter, Empire Post

Chairman: C. Earl Norquist, Norquist Products, Inc., Jamestown, N. Y.

Mohawk Valley Chapter, Empire Post

Chairman: Francis R. Gorman, Gorman & Halpern, Utica, N. Y.
Vice-Chairman: Thomas Bright, Revere Copper & Brass Company, Rome, N. Y.

Rochester Chapter, Empire Post

Chairman: Ray M. Biehler, 1260 Sibley Tower Building, Rochester, N. Y.
Vice-Chairman: Orrin J. Mitchell, Union Steel Chest Company, LeRoy, N. Y.
Program Chairman: Earl T. Gruendike, General Railway Signal Company, Rochester, N. Y.

Southern Tier Chapter, Empire Post

Chairman: Claude Wright, Webster Industries, Webster, N. Y.
Secretary: F. N. Tracy, Ward LaFrance Truck Corporation, Elmira, N. Y.

Syracuse-Central New York Chapter, Empire Post

Chairman: Robert I. Hicks, Lamson Corporation, Syracuse, N. Y.
First Vice-Chairman and Meeting Chairman: Paul L. Christensen, Onondaga Pottery Company, Syracuse, N. Y.
Second Vice-Chairman and Membership Chairman: Fred N. Claypole, Brown-Lipe-Chapin Division, GMC, Syracuse, N. Y.
Secretary: Gwyn Thomas, Manufacturers Association of Syracuse, Chamber of Commerce Building, Syracuse, N. Y.

Tri-Cities Chapter, Empire Post

Chairman: Stuart Newing, Newing Motor Company, Endicott, N. Y.

Florida Post, June 12, 1951

President: R. L. Dickson, Eglin Air Force Base, Fla.
First Vice-President: Gilbert Foster, Headquarters, A.F.A.C., Eglin Air Force Base, Fla.
Second Vice-President: J. L. Jenkins, Valpariso, Fla.
Secretary: H. L. Hawkins, Eglin Air Force Base, Fla.
Assistant Secretary: Anthony Casper, Eglin Air Force Base, Fla.
Corresponding Secretary: Miss Sue Cain, Eglin Air Force Base, Fla.
Treasurer: C. D. Longaker, Shalimar, Fla.
Directors: G. M. Corrigan, Coral Cables, Fla.
J. D. Cox, Eglin Air Force Base, Fla.
R. L. Dickson, Eglin Air Force Base, Fla.
Gilbert Foster, Headquarters, A.F.A.C., Eglin Air Force Base, Fla.
K. F. Fulton, Eglin Air Force Base, Fla.
A. D. Ginzburg, Eglin Air Force Base, Fla.
H. L. Hawkins, Eglin Air Force Base, Fla.
H. E. Heinecke, Valpariso, Fla.
R. C. Hoffman, Eglin Air Force Base, Fla.
J. L. Jenkins, Valpariso, Fla.
J. J. Murphy, Shalimar, Fla.
Robert Porter, Fort Walton, Fla.
C. R. Wilkerson, Eglin Air Force Base, Fla.

Hartford-Springfield Post, November 18, 1941

President: S. C. Hope, Esso Standard Oil Company, New York, N. Y.
Vice-Presidents: J. H. Chaplin, Veeder-Root, Inc., Hartford, Conn.
C. H. Granger, Waterbury, Conn.
Secretary-Treasurer: J. A. MacDonnell, Gilbert & Barker Manufacturing Company, West Springfield, Mass.
Directors: F. H. Payne, Springfield, Mass., *chairman;* the officers and
G. H. Anthony, Colt's Manufacturing Co., Hartford, Conn.
J. S. Begley, Holyoke, Mass.
E. P. Bullard, Bullard Company, Bridgeport, Conn.
F. U. Conard, Niles-Bement-Pond Company, West Hartford, Conn.
William J. Crowe, Springfield, Mass.
C. K. Davis, Remington Arms Company, Bridgeport, Conn.
G. H. Drewry, Niles-Bement-Pond Company, West Hartford, Conn.
W. M. Goss, Scovill Manufacturing Company, Waterbury, Conn.
James L. Guion, Springfield, Mass.
C. R. Hellstrom, Smith & Wesson, Inc., Springfield, Mass.
D. P. Hess, American Bosch Corporation, Springfield, Mass.
George E. Hughes, Springfield Ordnance District, Springfield, Mass.
L. E. Lentz, Underwood Corporation, Hartford, Conn.
D. G. Millar, Greenfield Tap and Die Corporation, Greenfield, Mass.
C. B. Parsons, American Hardware Corporation, New Britain, Conn.
H. H. Pease, New Britain Machine Company, New Britain, Conn.
R. E. Pritchard, Stanley Works, New Britain, Conn.
E. S. Pugsley, New Haven, Conn.
James Y. Scott, Van Norman Company, Springfield, Mass.
H. W. Steinkraus, Bridgeport Brass Company, Bridgeport, Conn.

Lone Star Post, June 12, 1945

President: Warren W. Wells, Axtell Company, Fort Worth, Tex.
Vice-President: R. H. Norris, Dearborn Stove Company, Dallas, Tex.
Secretary-Treasurer: W. M. Harrison, Crown Machine & Tool Company, Fort Worth, Tex.
Directors: C. A. Fischer, Harbison-Fischer Company, Fort Worth, Tex.
R. F. Flanagan, R. G. LeTourneau, Inc., Longview, Tex.
C. V. Fletcher, Dallas, Tex.
F. L. LeBus, LeBus Tool Company, Longview, Tex.
F. B. McKimball, Southwest Gauge Company, Dallas, Tex.
M. J. Neeley, Hobbs Manufacturing Company, Fort Worth, Tex.
John Wilson, Wilson Manufacturing Company, Wichita Falls, Tex.

Los Angeles Post, May 27, 1936

President: R. C. Geffs, Clary Multiplier Corporation, San Gabriel, Calif.
Vice-President: F. W. Conant, Douglas Aircraft Company, Santa Monica, Calif.
Treasurer: Samuel K. Rindge, Citizens National Trust & Savings Bank, Los Angeles, Calif.
Secretary: R. W. Reniers, Standard Coil Products Company, P. O. Box 2262, Terminal Annex, Los Angeles 54, Calif.
Directors: The officers and Thomas T. Arden, Robertshaw-Fulton Controls Company, Lynwood, Calif.
Louis G. Dunn, California Institute of Technology, Pasadena, Calif.
E. C. Hummell, Utility Steel Foundry, Vernon, Calif.
Earle M. Jorgenson, Earle M. Jorgenson Steel Company, Los Angeles, Calif.
Patrick Lizza, Bermite Powder Company, Saugus, Calif.
Walter C. Main, Oakland, Calif.
James P. McCafferty, Los Angeles, Calif.
Kenneth T. Norris, Norris-Thermador Corporation, Los Angeles, Calif.
John B. Rauen, Sr., U. S. Spring & Bumper Company, Los Angeles, Calif.

Carleton B. Tibbetts, Los Angeles Steel Casting Company, Los Angeles, Calif.
William A. Wilson, Web Wilson Oil Tools Company, Los Angeles, Calif.

Louisiana Post, May 24, 1950

Acting President: R. L. Telford, Silas Mason Company, Shreveport, La.
Acting Secretary-Treasurer: Ray Samuel, Higgins, Inc., New Orleans, La.
Directors: Russell A. Cuyler, Louisiana Power & Light Company, New Orleans, La.
J. Mason Guillory, New Orleans Public Service, Inc., New Orleans, La.
Ernest A. Merklein, Merklein and Company, Shreveport, La.
J. Edgar Monroe, Boland Machine & Manufacturing Company, New Orleans, La.
W. C. Nabors, W. C. Nabors Company, Mansfield, La.

Massachusetts Institute of Technology Post, January 20, 1922

President: Stanley A. Hoff, Cambridge, Mass.
Vice-President: Ernest P. Abrahamson, II, Cambridge, Mass.
Executive Committee: Julio B. Arroyo, Allen L. Klibanoff, and George Tsirkas, Cambridge, Mass.
Secretary-Treasurer: Robert H. Tucker, 362 Memorial Drive, Cambridge, Mass.
Faculty Adviser: Maj. William Mattis, Ordnance Corps, R.O.T.C. Ordnance Detachment, Massachusetts Institute of Technology, Cambridge, Mass.

Michigan Post, December 12, 1942

President: Charles L. Jacobson, Chrysler Motor Parts Corporation, Detroit, Mich.
Vice-Presidents: (*to be elected*).
Secretary-Treasurer: Charles W. Brownell, National Bank of Detroit, Detroit, Mich.
Directors: Thomas Couper, L. A. Young Spring & Wire Corporation, Detroit, Mich.
William M. Day, Michigan Bell Telephone Company, Detroit, Mich.
Irving A. Duffy, Ford Motor Company, Detroit, Mich.
J. Frank Forster, Vickers, Inc., Detroit, Mich.
James K. Fulks, Ex-Cell-O Corporation, Detroit, Mich.
Britton L. Gordon, Blackmer Pump Company, Grand Rapids, Mich.
John F. Gordon, General Motors Corporation, Detroit, Mich.
Charles L. Jacobson, Chrysler Motor Parts Corporation, Detroit, Mich.
V. H. Kendall, Universal Products Company, Dearborn, Mich.
C. Jack Reese, Continental Aviation & Engineering Corporation, Muskegon, Mich.
Joseph S. Sherer, Jr., Reo Motors, Inc., Lansing, Mich.
J. Thomas Smith, Detroit Harvester Company, Detroit, Mich.
F. Russell Valpey, Standard Products Company, Detroit, Mich.
Herbert R. White, Eclipse Counterbore Company, Ferndale, Mich.
A. M. Wibel, Nash-Kelvinator Corporation, Detroit, Mich.

Lansing Chapter, Michigan Post

President: Lester F. Carlson, Oldsmobile Division, GMC, Lansing, Mich.
Vice-President: Glen Whisler, Reo Motors, Inc., Lansing, Mich.
Secretary: Eldon Robbins, John Bean Division, Food Machinery & Chemical Corporation, Lansing 4, Mich.
Directors: Lee O. Benner, Motor Wheel Corporation, Lansing, Mich.
Barney C. Cox, Melling Forging Company, Lansing, Mich.
Frederik Marin, Bank of Lansing, Lansing, Mich.
Clarence A. Trump, Fisher Body Division, GMC, Lansing, Mich.

Western Michigan Chapter, Michigan Post

Secretary: Britton L. Gordon, Blackmer Pump Company, Grand Rapids, Mich.
Directors: Britton L. Gordon, Blackmer Pump Company, Grand Rapids, Mich.
Elisha Gray, II, Whirlpool Corporation, Saint Joseph, Mich.
S. K. Harrington, A-B Stoves, Battle Creek, Mich.
George Roderick, American Seating Company, Grand Rapids, Mich.
Frederick Vogt, Knape and Vogt Manufacturing Company, Grand Rapids, Mich.
Roger Waindle, Muskegon, Mich.

Mid-Continent Post, December 12, 1944

President: M. H. Johnson, Independent Plow, Inc., Neodesha, Kans.
Vice-President: R. R. King, American Body & Trailer Company, Oklahoma City, Okla.
Consulting Engineer: W. H. Steuve, Oklahoma City, Okla.
Secretary-Treasurer: C. R. Horton, Horton Engineering Company, 8211 E. Seventh Street, Tulsa, Okla.
Directors: Frank Hinderliter, Tulsa, Okla.
George Nicholson, Tulsa, Okla.
Walter O'Bannon, Jr., Tulsa, Okla.
Ed Warmack, Warmack Stove Company, Fort Smith, Ark.

Midwest Post, May 16, 1945

President: Harry Darby, Darby Corporation, Kansas City, Kans.
Vice-President: C. M. Standiford, Crawford Manufacturing Company, Kansas City, Kans.
Secretary-Treasurer: Fred B. Nichols, Mid-Continent Paint Manufacturing Company, 1921 Central Street, Kansas City 8, Mo.
Directors: Leroy M. Alexander, Sheffield Steel Corporation, Kansas City, Mo.
Paul Froeschl, Wilde Drop Forge & Tool Company, Kansas City, Mo.
Elmer Pierson, Vendo Company, Kansas City, Mo.
Philip Rahm, Kansas City, Mo.
Kenneth Spencer, Spencer Chemical Company, Kansas City, Mo.

Milwaukee Post, September 26, 1928

President: Frederick D. Hansen, Evans-Hansen, Milwaukee, Wis.
Vice-President: N. Rulison Knox, Bucyrus-Erie Company, South Milwaukee, Wis.
Secretary-Treasurer: Jacobus Kruyne, Home Savings Bank, 2200 North Third Street, Milwaukee, Wis.
Directors: P. H. Batten, Twin-Disk Clutch Company, Racine, Wis.
Leon R. Clausen, J. I. Case Company, Racine, Wis.
W. W. Coleman, Bucyrus-Erie Company, South Milwaukee, Wis.
J. E. De Long, Waukesha Motors Corporation, Waukesha, Wis.
Harold S. Falk, Falk Corporation, Milwaukee, Wis.
George H. Fobian, Oilgear Company, Milwaukee, Wis.
Frederick D. Hansen, Evans-Hansen, Milwaukee, Wis.
W. C. Heath, A. O. Smith Corporation, Milwaukee, Wis.
H. Stanley Johnson, Jr., Gisholt Machine Company, Madison, Wis.
N. Rulison Knox, Bucyrus-Erie Company, South Milwaukee, Wis.
Herbert V. Kohler, Kohler Company, Kohler, Wis.
J. Clifford Merwin, Chain Belt Company, Milwaukee, Wis.
William A. Roberts, Allis-Chalmers Manufacturing Company, West Allis, Wis.

Robert A. Uihlein, Jos. Schlitz Brewing Company, Milwaukee, Wis.
Pierpont J. E. Wood, Jeffres, Mouat, Oestreich, Wood & Cunningham, Janesville, Wis.

Nebraska Post, June 22, 1944

Acting President: John McCague, Jubilee Manufacturing Company, Omaha, Nebr.
Secretary-Treasurer: Fred G. Arkoosh, P. O. Box 127, Florence Station 12, Omaha, Nebr.
Directors: Robert H. Ammon, Cushman Motor Works, Lincoln, Nebr.
Robert Bernstein, Independent Metal Products, Omaha, Nebr.
Dana Bradford, Bradford-Kennedy Company, Omaha, Nebr.
F. H. Bucholz, Omaha Steel Works, Omaha, Nebr.
Clyde Dempster, Dempster Mill Manufacturing Company, Beatrice, Nebr.
Karl Vogel, State Senator, Omaha, Nebr.

New York Post, June 15, 1921

President: George F. Hussey, Jr., American Standards Association, New York, N. Y.
Vice-Presidents: J. L. Auer, R. Hoe & Company, New York, N. Y.
H. T. Luria, Luria Steel & Trading Corporation, New York, N. Y.
R. L. Maxwell, American Machine & Foundry Company, New York, N. Y.
J. G. Phillips, International Business Machines Corporation, New York, N. Y.
Secretary-Treasurer: Lyman F. Stangel, New York Ordnance District, 180 Varick Street, New York 14, N. Y.
Directors: George W. Allison, Locust Cove, Kings Point, N. Y.
T. F. Brown, National Distillers Products Corporation, New York, N. Y.
Paul T. Cullen, Sperry Gyroscope Company, Great Neck, N. Y.
William E. Eisner, American Visuals Corporation, New York, N. Y.
C. L. Farrand, Farrand Optical Company, Bronx, N. Y.
W. R. Janney, National Can Corporation, New York, N. Y.
D. B. MacMaster, D. Blair MacMaster Company, New York, N. Y.
Chester E. Mueller, 830 Broad Street, Newark, N. J.
Herman A. Peterson, Intertype Corporation, Brooklyn, N. Y.
H. N. Sachs, Frank Crystal & Company, New York, N. Y.
Lloyd W. Stearns, Metropolitan Life Insurance Company, New York, N. Y.
A. E. Van Cleve, Crucible Steel Company of America, New York, N. Y.

Northwest Post, March 15, 1945

President: W. C. MacFarlane, Sr., Minneapolis-Moline Company, Minneapolis, Minn.
Vice-Presidents: Harold W. Sweatt, Minneapolis-Honeywell Regulator Company, Minneapolis, Minn.
Charles L. Horn, Federal Cartridge Corporation, Minneapolis, Minn.
Secretary-Treasurer: Roland F. Wilson, 436 Palace Building Minneapolis 1, Minn.
Directors: The officers and Albert P. Baston, Baston Motor Company, St. Cloud, Minn.
Fred Blumers, General Mills, Inc., Minneapolis, Minn.
P. G. Bourne, Seeger Refrigerator Company, St. Paul, Minn.
Charles E. Buckbee, Buckbee Mears Company, St. Paul, Minn.
Harry A. Bullis, General Mills, Inc., Minneapolis, Minn.
Walter F. Kasper, Fairmont Railway Motors, Inc., Fairmont, Minn.
Warren C. MacFarlane, Jr., Minneapolis-Moline Company, Minneapolis, Minn.
Henry J. Neils, Flower City Ornamental Iron Company, Minneapolis, Minn.
Luther S. Oakes, Winston Brothers Company, Minneapolis, Minn.
David W. Onan, D. W. Onan & Sons, Inc., Minneapolis, Minn.
George H. Rozum, Rozum Brothers Motors Company, Watertown, S. Dak.
Walter G. Seeger, Seeger Refrigerator Company, St. Paul, Minn.
Donald A. Smith, Smith, Inc., Fargo, N. Dak.
Alton V. Stallard, San Francisco, Calif.
Alfred M. Wilson, Minneapolis-Honeywell Regulator Company, Minneapolis, Minn.
Frank B. Winston, Winston Brothers Company, Minneapolis, Minn.
Brison Wood, Minneapolis-Honeywell Regulator Company, Minneapolis, Minn.

Philadephia Post, December 9, 1926

President: Albert W. Gilmer, Barnes, Dechert, Price, Myers & Rhoads, Philadelphia, Pa.
Vice-Presidents: Howard S. Lewis, Parish Pressed Steel Company, Reading, Pa.
William S. Worrilow, Lebanon Steel Foundry, Lebanon, Pa.
Edward G. Budd, Jr., Budd Company, Philadelphia, Pa.
Walter C. Pew, Philadelphia, Pa.
Secretary-Treasurer: Robert T. Gebler, Room 1138, Lincoln Liberty Building, Philadelphia 7, Pa.
Directors: Henry W. Gadsden, Sharp & Dohme, Philadelphia, Pa.
H. Paul Gant, Glen Moore, Pa.
Joseph H. Gillies, Philco Corporation, Philadelphia, Pa.
C. Jared Ingersoll, Kansas, Oklahoma & Gulf Railway Company, Philadelphia, Pa.
Ernest J. Langham, Sun Oil Company, Philadelphia, Pa.
Stewart E. Lauer, York Corporation, York, Pa.
George P. Luckey, Hamilton Watch Company, Lancaster, Pa.
Henry N. Marsh, Hercules Powder Company, Wilmington, Del.
William J. Meinel, Heintz Manufacturing Company, Philadelphia, Pa.
Howard C. Petersen, Fidelity-Philadelphia Trust Company, Philadelphia, Pa.
Walter C. Pew, Philadelphia, Pa.
Marshall Post, Birdsboro Steel Foundry & Machine Company, Birdsboro, Pa.
Charles S. Redding, Leeds & Northrup Company, Philadelphia, Pa.
Martin Sandler, Daytona Beach, Fla.
J. T. Simpson, Harrisburg Steel Corporation, Harrisburg, Pa.
Arthur J. Seiler, Main Belting Company, Philadelphia, Pa.
George W. Struble, Bethlehem Steel Company, Bethlehem, Pa.
Marvin W. Smith, Baldwin-Lima-Hamilton Corporation, Eddystone, Pa.
Everett B. Webster, Crown Can Company, Philadelphia, Pa.
Henry H. Ziesing, Midvale Company, Philadelphia, Pa.

Pittsburgh Post, February 24, 1927

President: Alexander E. Walker, National Supply Company, Pittsburgh, Pa.
Vice-Presidents: Thomas E. Millsop, Weirton Steel Company, Weirton, W. Va.
Clifford F. Hood, United States Steel Corporation, Pittsburgh, Pa.
Treasurer: Thomas H. Eddy, George A. Kelly Company, Pittsburgh, Pa.
Secretary: William S. Rial, Jr., 2101 Clark Building, Pittsburgh 22, Pa.
Directors: The officers and John A. Appleton, Pennsylvania Railroad Company, Pittsburgh, Pa.
Frank R. Denton, Mellon National Bank & Trust Company, Pittsburgh, Pa.

Robert C. Downie, Peoples First National Bank & Trust Company, Pittsburgh, Pa.
Robert C. Enos, Standard Steel Spring Division, Rockwell Spring and Axle Company, Coraopolis, Pa.
William K. Fitch, Dravo Corporation, Pittsburgh, Pa.
Kirkland C. Gardner, United Engineering & Foundry Company, Pittsburgh, Pa.
Harry B. Higgins, Pittsburgh Plate Glass Company, Pittsburgh, Pa.
Lorenz Iversen, Mesta Machine Company, West Homestead, Pa.
George H. Love, Pittsburgh-Consolidation Coal Company, Pittsburgh, Pa.
Ben Moreell, Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Gwilym A. Price, Westinghouse Electric Manufacturing Corporation, Pittsburgh, Pa.
Brehon B. Somervell, Koppers Company, Pittsburgh, Pa.
Sidney A. Swensrud, Gulf Oil Corporation, Pittsburgh, Pa.
Alexander E. Walker, National Supply Company, Pittsburgh, Pa.
Irving W. Wilson, Aluminum Company of America, Pittsburgh, Pa.

Puget Sound Post, January 25, 1944

President: C. Walter Huffine, Massachusetts Mutual Life Insurance Company, Seattle, Wash.
Vice-President: Alex Thomson, Pacific Car and Foundry Company, Renton, Wash.
Secretary-Treasurer: Fairman B. Lee, Fairman B. Lee Company, Seattle, Wash.
Directors: Murray Aitken, Kenworth Motor Truck Corporation, Seattle, Wash.
Joseph A. Denn, Pacific Powder Company, Tacoma, Wash.
Watt Fallis, Kenworth Motor Truck Corporation, Seattle, Wash.
Paul Forsyth, Western Gear Works, Seattle, Wash.
H. P. Lawrence, Northwest Lead Company, Seattle, Wash.
George C. Martin, Boeing Airplane Company, Seattle, Wash.
Robert Nelson, Standard Service Tire Company, Seattle, Wash.
Ferdinand Schmitz, Berger Engineering Company, Spokane, Wash.
Alex Thomson, Pacific Car and Foundry Company, Renton, Wash.
Walter Toly, Columbia Electric Company, Spokane, Wash.
M. J. Williams, Seattle Office, San Francisco Ordnance District, Seattle, Wash.

Quad Cities-Iowa Post, May 28, 1945

President: P. S. Mumford, American Machine & Metals, Inc., East Moline, Ill.
Vice-President: C. E. Murray, Englehart Manufacturing Company, Davenport, Iowa.
Secretary-Treasurer: Donald L. Meyers, Rock Island Arsenal, Rock Island, Ill.
Directors: A. A. Collins, Collins Radio Company, Cedar Rapids, Iowa.
A. C. Danekind, The Maytag Company, Newton, Iowa.
L. M. Gildea, International Harvester Company, Rock Island, Ill.
G. H. Mathes, Iowa Ordnance Plant, Burlington, Iowa.
A. D. Matheson, French & Hecht Division, Kelsey-Hayes Wheel Company, Davenport, Iowa.
L. A. Murphy, Deere & Company, Moline, Ill.
E. W. Ross, Minneapolis-Moline Company, Moline, Ill.
M. M. Schmidt, Deere Manufacturing Company, Des Moines, Iowa.
G. A. Uhlmeyer, Iowa-Illinois Gas & Electric Company, Rock Island, Ill.
C. A. Waldman, Deere & Company, Moline, Ill.
W. W. Warner, Rock Island Arsenal, Rock Island, Ill.
G. L. Weissenburger, Keokuk Electro-Metals Company, Keokuk, Iowa.
C. D. Wiman, Deere & Company, Moline, Ill.

Rio Grande Post, November 6, 1952

President: Henry E. Minton, El Paso, Tex.
Vice-President: M. S. Darbyshire, Darbyshire Steel Company, El Paso, Tex.
Secretary-Treasurer: C. A. Lindeman, Darbyshire Steel Company, El Paso, Tex.
(*Other officers and directors to be elected.*)

Rocky Mountain Post, June 10, 1942

President: James D. Maitland, Cobusco Steel Products, Denver, Colo.
Vice-President: James Colasanti, Metal Treating & Research Company, Denver, Colo.
Secretary-Treasurer: Gerould A. Sabin, Colorado Fuel & Iron Corporation, Room 806, Continental Oil Building, Denver, Colo.
Directors: C. C. Drake, Griffin Wheel Company, Denver, Colo.
Fred R. Eberhardt, Eberhardt-Denver Company, Denver, Colo.
Benjamin C. Essig, Gardner-Denver Company, Denver, Colo.
J. K. Garretson, Republic Steel Corporation, Denver, Colo.
John G. Gates, Gates Rubber Company, Denver, Colo.
Robert P. Gutshall, Colorado Tent & Awning Company, Denver, Colo.
Marvin M. Millsop, Denver, Colo.
William M. Reno, Bill Reno, Inc., Denver, Colo.
Stanley C. Shubart, Schloss & Shubart, Denver, Colo.
Harold F. Silver, Silver Engineer Works, Denver, Colo.
T. C. Timpte, Timpte Brothers, Denver, Colo.
C. W. Webb, Armco Drainage & Metal Products Company, Denver, Colo.
Adolph D. Weiss, Winter-Weiss Company, Denver, Colo.

St. Louis Post, January 18, 1927

President: Walter Siegerist, Medart Company, St. Louis, Mo.
Vice-President: William P. Gatley, National Rejectors, Inc., St. Louis, Mo.
Secretary: Irvin L. Jerger, St. Louis Ordnance District, St. Louis, Mo.
Treasurer: Winfield E. Hartford, St. Louis Air Regional Office, Clayton, Mo.
Directors: W. M. Akin, Laclede Steel Company, St. Louis, Mo.
J. I. Bandy, U. S. Naval Air Station, St. Louis, Mo.
F. G. Bryan, St. Louis Ordnance District, St. Louis, Mo.
Carlisle F. Ferris, Scott Air Force Base, Belleville, Ill.
Aaron Fisher, Universal Match Corporation, St. Louis, Mo.
Russell E. Gardner, Jr., Reinholdt & Gardner, St. Louis, Mo.
Stanley Jackes, Jackes-Evans Manufacturing Company, St. Louis, Mo.
Edward F. Judge, Scullin Steel Company, St. Louis, Mo.
John N. Marshall, Granite City Steel Company, Granite City, Ill.
J. Wesley McAfee, Union Electric Company of Missouri, St. Louis, Mo.
Edwin B. Meissner, St. Louis Car Company, St. Louis, Mo.
Clyde H. Morgan, Emerson Electric Manufacturing Company, St. Louis, Mo.
Wallace A. Morse, St. Louis Ordnance District, St. Louis, Mo.
John M. Olin, Olin Industries, Inc., East Alton, Ill.
L. J. Sverdrup, Sverdrup & Parcel, Inc., St. Louis, Mo.

San Francisco Post, October 17, 1923

President: B. C. Heacock, Caterpillar Tractor Company, San Francisco, Calif.
Vice-Presidents: Lawrence S. Fletcher, Piedmont, Calif.
G. M. Greenwood, Rheem Manufacturing Company, Richmond, Calif.
Secretary-Treasurer: M. W. Harris, San Francisco Ordnance District, 1515 Clay Street, Oakland 12, Calif.
Directors: The officers and William H. Carr, California Packing Corporation, San Francisco, Calif.

John E. Cushing, Oceanic Steamship Company, San Francisco, Calif.
Edgar B. Jessup, Marchant Calculators, Inc., Oakland, Calif.
A. B. Layton, Crown Zellerbach Corporation, San Francisco, Calif.
George Murray, San Francisco, Calif.
Elmer R. Peterson, Standard Oil Company of California, San Francisco, Calif.
D. A. Rhoades, Kaiser Aluminum & Chemical Corporation, Oakland, Calif.
Jean C. Witter, Dean Witter & Company, San Francisco, Calif.

Texas Post, October 30, 1942

President: W. O. Hedrick, McEvoy Company, Houston, Tex.
Vice-President: W. H. Miner, Lufkin Foundry & Machine Company, Houston, Tex.
Secretary-Treasurer: Leo S. Bassett, Department of the Army, Dickson Gun Plant, P. O. Box 2545, Houston, Tex.
Directors: K. P. Campbell, Sheffield Steel Corporation, Houston, Tex.
M. I. Kearns, Brown & Root, Inc., Houston, Tex.
Phillip P. Krumb, Sr., Rheem Manufacturing Company, Houston, Tex.
O. L. Lorchn, Cameron Iron Works, Houston, Tex.
D. J. Martin, Hughes Tool Company, Houston, Tex.
R. D. Springer, Houston Regional Office, St. Louis Ordnance District, Houston, Tex.

University of Michigan Post, February 20, 1941

President: Gerald J. Underwood, University of Michigan, Ann Arbor, Mich.
Faculty Adviser: Wesley O. Moberg, R.O.T.C. Detachment, University of Michigan, Ann Arbor, Mich.
(*Officers and directors to be elected.*)

Washington Post, November 18, 1925

President: Ludlow King, Universal Moulded Products Corporation, Washington, D. C.
Vice-Presidents: Fred T. Marshall, B. F. Goodrich Company, Washington, D. C.
T. J. McCloskey, Bureau of Ordnance, U. S. Navy, Washington, D. C.
Secretary-Treasurer: W. J. Sears, Rubber Manufacturers' Association, Washington, D. C.
Directors: H. N. Arbuthnot, Allegheny Ludlum Steel Corporation, Washington, D. C.
A. V. Astin, National Bureau of Standards, Washington, D. C.
E. L. Cummings, Ordnance Corps, U. S. Army, Washington, D. C.
George E. Engelmann, Studebaker Corporation, Washington, D. C.
A. H. Hobelmann, Walter Kidde & Company, Washington, D. C.
E. Willard Jensen, Motor Products Corporation, Washington, D. C.
W. G. Lockwood, American Locomotive Company, Washington, D. C.
Gerald J. Lynch, Ford Motor Company, Washington, D. C.
A. F. MacConochie, University of Virginia, Charlottesville, Va.
George M. Riveire, Goodyear Tire & Rubber Company, Washington, D. C.
Robert F. Willey, Bethlehem Steel Corporation, Washington, D. C.
Edward L. Woodyard, Naval Ordnance Laboratory, White Oak, Md.

Yankee Post, June 30, 1925

President: Helge Holst, Arthur D. Little, Inc., Cambridge, Mass.
Vice-Presidents: M. Edgar Fain, Tower Iron Works, Providence, R. I.
Charles B. Weeks, Hesse-Eastern Corporation, Cambridge, Mass.
John K. Ames, Burrows Corporation, Portland, Maine.
Secretary-Treasurer: John C. Dieselman, Morse-Smith-Morse Company, Watertown, Mass.
Directors: John K. Ames, Burrows Corporation, Portland, Maine.
Charles C. Bell, Universal Winding Company, Cranston, R. I.
J. Hugh Bolton, Whitin Machine Company, Whitinsville, Mass.
J. J. Brogan, Jefferson Electric Company, Fall River, Mass.
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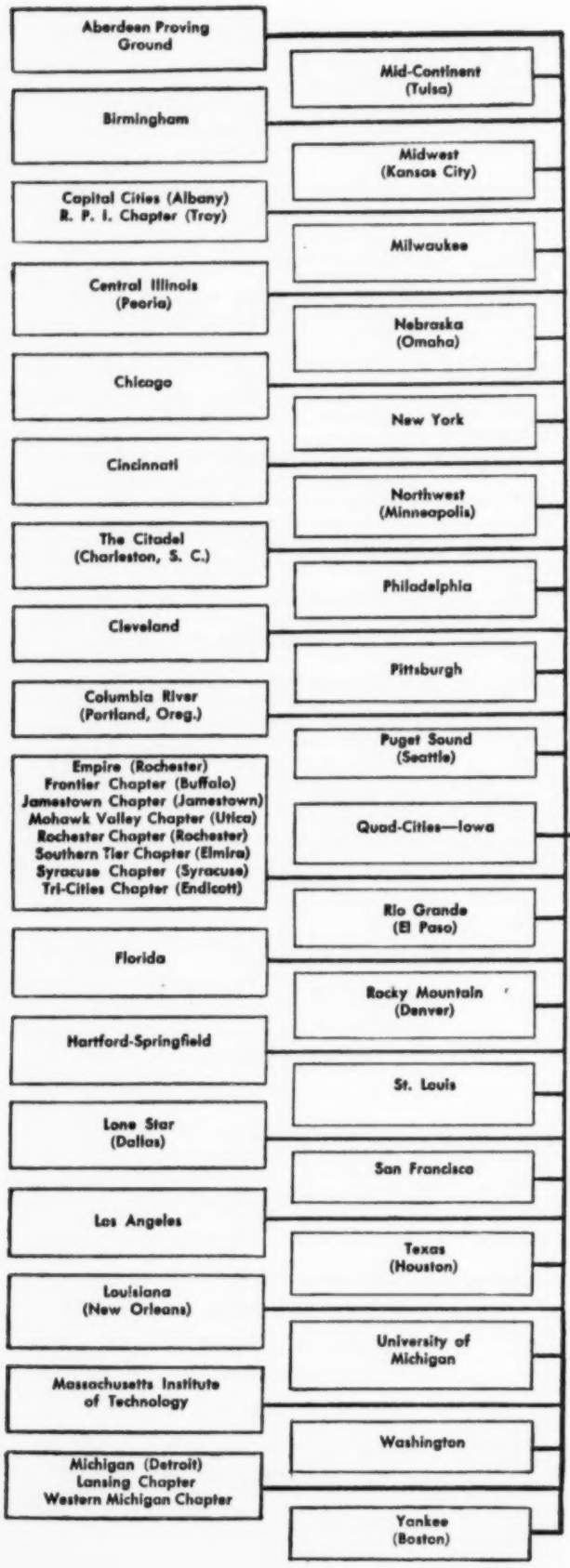

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ARNOLD ENGINEERING COMPANY . . MARENGO, ILL.
ARNOLT CORPORATION . . . . WARSAW, IND.
ARO EQUIPMENT CORPORATION . . . BRYAN, OHIO
ART METAL CONSTRUCTION COMPANY, JAMESTOWN, N.Y.
ARVIN INDUSTRIES, INC. . . . . COLUMBUS, IND.
ASSOCIATED SPRING CORPORATION . BRISTOL, CONN.
ATLANTIC INDIA RUBBER WORKS, INC. CHICAGO, ILL.
ATLAS DROP FORGE COMPANY . . LANSING, MICH.
ATLAS FOUNDRY COMPANY . . . DETROIT, MICH.
ATLAS POWDER COMPANY . . . WILMINGTON, DEL.
ATLAS STEEL CONSTRUCTION COMPANY, NEW YORK, N.Y.
AULD COMPANY, D. L. . . . . COLUMBUS, OHIO
AUSTERBERRY'S SONS, J. C. . . . DETROIT, MICH.
AUSTIN POWDER COMPANY . . CLEVELAND, OHIO
AUTO SPECIALTIES MANUFACTURING COMPANY . . . . . ST. JOSEPH, MICH.
AUTOCAR DIVISION, WHITE MOTOR COMPANY . . . . . ARDMORE, PA.
AUTOMATIC MACHINE PRODUCTS COMPANY . . . . . ATTLEBORO, MASS.
AUTOMOTIVE FABRICATORS, INC. . . DETROIT, MICH.
AUTOMOTIVE MATERIALS CORPORATION DETROIT, MICH.
AUTOMOTIVE RUBBER COMPANY . . DETROIT, MICH.
AUTOMOTIVE SOLVENTS & SPECIALTIES, INC. . . ST. CLAIR SHORES, MICH.

BADGER METER MANUFACTURING COMPANY . . . . . MILWAUKEE, WIS.
BAGLEY & SEWELL COMPANY . . WATERTOWN, N.Y.
BAILEY PRODUCTS CORPORATION . . UNION CITY, IND.
BAIRD ASSOCIATES, INC. . . . CAMBRIDGE, MASS.
BAKER & COMPANY, INC. . . . . NEWARK, N.J.
BAKER & COMPANY, HUGH J. . . INDIANAPOLIS, IND.
BAKER OIL TOOLS, INC. . . . LOS ANGELES, CALIF.
BALDT ANCHOR, CHAIN & FORGE DIVISION, BOSTON METALS COMPANY . . . CHESTER, PA.
BALDWIN COMPANY . . . . CINCINNATI, OHIO
BALDWIN-LIMA-HAMILTON CORPORATION . . . . . PHILADELPHIA, PA.
BALTIMORE AND OHIO RAILROAD COMPANY . . . . . BALTIMORE, MD.
BALTIMORE STEEL WORKS . . . . BALTIMORE, MD.
BARDEN CORPORATION . . . . DANBURY, CONN.
BARIUM STEEL CORPORATION . . . NEW YORK, N.Y.
BARKSDALE MANUFACTURING COMPANY . . . . . BLYTHEVILLE, ARK.
BARNES COMPANY, W. F. & JOHN . . ROCKFORD, ILL.
BASALT ROCK COMPANY . . . . . NAPA, CALIF.
BASCA MANUFACTURING COMPANY INDIANAPOLIS, IND.
BASTIAN-BLESSING COMPANY . . . CHICAGO, ILL.
BASTIAN-MORLEY COMPANY . . . LA PORTE, IND.
BATH & COMPANY, JOHN . . . WORCESTER, MASS.
BAUER BROTHERS COMPANY . . SPRINGFIELD, OHIO
BAUSCH & LOMB OPTICAL COMPANY . ROCHESTER, N.Y.
BEAIRD COMPANY, J. B. . . . . SHREVEPORT, LA.
BEAR MANUFACTURING COMPANY . ROCK ISLAND, ILL.
BEHR-MANNING CORPORATION . . . TROY, N.Y.
BELL AIRCRAFT CORPORATION . . BUFFALO, N.Y.
BELL TELEPHONE COMPANY OF PENNSYLVANIA . . . . . PHILADELPHIA, PA.
BELL TELEPHONE LABORATORIES, INC. NEW YORK, N.Y.
BELMET PRODUCTS, INC. . . . . BROOKLYN, N.Y.
BELOCK INSTRUMENT CORPORATION, COLLEGE POINT, N.Y.
BENDIX AVIATION CORPORATION . . DETROIT, MICH.
BENDIX-WESTINGHOUSE AUTOMOTIVE AIR BRAKE COMPANY . . . . . ELYRIA, OHIO
BENEDICT-MILLER, INC. . . . . NEWARK, N.J.
BERYLLIUM CORPORATION . . . . READING, PA.
BETHLEHEM STEEL COMPANY . . . BETHLEHEM, PA.
BETTER BRUSHES, INC. . . . . PALMER, MASS.
BETTINGER CORPORATION . . . . WALTHAM, MASS.
B G CORPORATION . . . . . NEW YORK, N.Y.
BIEDERMAN MOTORS CORPORATION . CINCINNATI, OHIO
BIRD & SON, INC. . . . . EAST WALPOLE, MASS.
BIRDSBORO STEEL FOUNDRY & MACHINE COMPANY . . . . . BIRDSBORO, PA.
BIRMINGHAM PAPER COMPANY . BIRMINGHAM, ALA.
BIRTMAN ELECTRIC COMPANY . . . CHICAGO, ILL.
BLACK & DECKER MANUFACTURING CO. TOWSON, MD.
BLACK-CLAWSON COMPANY . . . HAMILTON, OHIO
BLACK ROCK MANUFACTURING COMPANY . . . . . BRIDGEPORT, CONN.
BLACKMER PUMP COMPANY . GRAND RAPIDS, MICH.
BLACKSTONE CORPORATION . . JAMESTOWN, N.Y.
BLANCHARD MACHINE COMPANY . CAMBRIDGE, MASS.
BLAW-KNOX COMPANY . . . . BLAWNOX, PA.
BLISS COMPANY, E. W. . . . . CANTON, OHIO
BOEHM PRESSED STEEL COMPANY . CLEVELAND, OHIO
BOHN ALUMINUM & BRASS CORP. . . DETROIT, MICH.
BORG CORPORATION, GEO. W. . . . DELAVAN, WIS.
BORG-WARNER CORPORATION . . . CHICAGO, ILL.
BOSTITCH, INC. . . . . WESTERLY, R.I.
BOTANY MILLS . . . . . PASSAIC, N.J.
BOUND BROOK OIL-LESS BEARING COMPANY . . . . . BOUND BROOK, N.J.
BOUTELL DRIVEAWAY COMPANY, F. J. DETROIT, MICH.
BOWEN & MCLAUGHLIN . . . . PHOENIX, ARIZ.
BOWER ROLLER BEARING COMPANY . DETROIT, MICH.
BOWSER, INC. . . . . FORT WAYNE, IND.
BOYERTOWN AUTO BODY WORKS . . BOYERTOWN, PA.
BRADEN STEEL CORPORATION . . . TULSA, OKLA.
BREEZE CORPORATIONS, INC. . . . NEWARK, N.J.
BREWSTER COMPANY . . . . . SHREVEPORT, LA.
BRIDGEPORT BRASS COMPANY . . BRIDGEPORT, CONN.
BRIGGS & STRATTON CORPORATION MILWAUKEE, WIS.

Honor Roll of Industrial Preparedness

BRIGGS MANUFACTURING COMPANY . DETROIT, MICH.
BRIGHTON SCREW & MANUFACTURING COMPANY . . . . . CINCINNATI, OHIO
BRILLO MANUFACTURING COMPANY . NEW YORK, N.Y.
BRISKIN MANUFACTURING COMPANY . . CHICAGO, ILL.
BRISTOL BRASS CORPORATION . . BRISTOL, CONN.
BRISTOL MACHINE TOOL COMPANY, FORESTVILLE, CONN.
BROEN METAL PRODUCTS, INC. . . DETROIT, MICH.
BROOK & PERKINS . . . . . DETROIT, MICH.
BROWN & BIGELOW . . . . . ST. PAUL, MINN.
BROWN & ROOT, INC. . . . . HOUSTON, TEX.
BROWN & SHARPE MANUFACTURING COMPANY . . . . . PROVIDENCE, R.I.
BROWN COMPANY . . . . . BOSTON, MASS.
BRYANT CHUCKING GRINDER COMPANY, SPRINGFIELD, VT.
BUCHMANN SPARK WHEEL CORPORATION . . . LONG ISLAND CITY, N.Y.
BUCKEYE IRON & BRASS WORKS . . DAYTON, OHIO
BUCKEYE STEEL CASTINGS COMPANY . COLUMBUS, OHIO
BUCKINGHAM MANUFACTURING COMPANY . . . . . BINGHAMTON, N.Y.
BUCYRUS-ERIE COMPANY . SOUTH MILWAUKEE, WIS.
BUDD COMPANY . . . . . DETROIT, MICH.
BUDD COMPANY . . . . . PHILADELPHIA, PA.
BUICK MOTOR DIVISION, GMC . . . . FLINT, MICH.
BUICK-OLDSMOBILE-PONTIAC ASSEMBLY DIVISION, GMC . . . . . SOUTH GATE, CALIF.
BUILDERS IRON FOUNDRY . . . . PROVIDENCE, R.I.
BUILDERS STRUCTURAL STEEL CORPORATION . . . . . CLEVELAND, OHIO
BULLDOG ELECTRIC PRODUCTS COMPANY, DETROIT, MICH.
BULOVA WATCH COMPANY . . . NEW YORK, N.Y.
BUNDY TUBING COMPANY . . . . DETROIT, MICH.
BUNTING GLIDER COMPANY . . PHILADELPHIA, PA.
BURGESS-NORTON MFG. COMPANY . . GENEVA, ILL.
BURKE COMPANY, O. W. . . . . DETROIT, MICH.
BURLINGTON BRASS WORKS . . BURLINGTON, WIS.
BURNDY ENGINEERING COMPANY . . NORWALK, CONN.
BURROUGHS CORPORATION . . . DETROIT, MICH.
BURT COMPANY, F. N. . . . . BUFFALO, N.Y.
BUSCHMAN COMPANY, E. W. . . CINCINNATI, OHIO
BUTTERWORTH & SONS COMPANY, H. W., BETH AYRES, PA.

CADILLAC MALLEABLE IRON COMPANY, CADILLAC, MICH.
CADILLAC MOTOR CAR DIVISION, GMC DETROIT, MICH.
CADILLAC MOTOR CAR DIVISION, GMC, CLEVELAND TANK PLANT . . CLEVELAND, OHIO
CADILLAC PRODUCTS, INC. . . . FERNDALE, MICH.
CALLAHAN CAN MACHINE COMPANY . BROOKLYN, N.Y.
CAMERON IRON WORKS, INC. . . . HOUSTON, TEX.
CAMPBELL CHAIN COMPANY . . . . YORK, PA.
CAMPBELL, WYANT AND CANNON FOUNDRY COMPANY . . . . . MUSKEGON, MICH.
CANFIELD RUBBER COMPANY . . BRIDGEPORT, CONN.
CAPITAL PRODUCTS, INC. . . LONG ISLAND CITY, N.Y.
CARBOLOY COMPANY . . . . . DETROIT, MICH.
CARBORUNDUM COMPANY . . . NIAGARA FALLS, N.Y.
CAREY-MCFALL COMPANY . . . PHILADELPHIA, PA.
CARRIER CORPORATION . . . . SYRACUSE, N.Y.
CARTER CARBURETOR CORPORATION . ST. LOUIS, MO.
CASCO PRODUCTS CORPORATION . BRIDGEPORT, CONN.
CASE COMPANY, J. I. . . . . RACINE, WIS.
CATAWISSA VALVE & FITTINGS COMPANY, CATAWISSA, PA.
CATERPILLAR TRACTOR CO. . . . . PEORIA, ILL.
C. E. M. COMPANY . . . . . DAYVILLE, CONN.
CENTRAL BOILER & MANUFACTURING CO., DETROIT, MICH.
CENTRAL CAN COMPANY . . . . CHICAGO, ILL.
CENTRAL FOUNDRY COMPANY . . NEWARK, N.J.
CENTURY ELECTRIC COMPANY . . ST. LOUIS, MO.
CENTURY ENGINEERING CORPORATION . . . . . CEDAR RAPIDS, IOWA
CHAFFEE BROTHERS COMPANY . . OXFORD, MASS.
CHAIN BELT COMPANY . . . . MILWAUKEE, WIS.
CHAMBERSBURG ENGINEERING COMPANY . . . . . CHAMBERSBURG, PA.
CHAMPION SPARK PLUG COMPANY . TOLEDO, OHIO
CHANCE COMPANY, A. B. . . . . CENTRALIA, MO.
CHASE AIRCRAFT COMPANY . WEST TRENTON, N.J.
CHASE BRASS & COPPER COMPANY WATERBURY, CONN.
CHECKER CAB MANUFACTURING CORPORATION . . . . . KALAMAZOO, MICH.
CHEMICAL CONSTRUCTION CORPORATION . . . . . NEW YORK, N.Y.
CHEVROLET MOTOR DIVISION, GMC . DETROIT, MICH.
CHICAGO EXTRUDED METALS COMPANY . CICERO, ILL.
CHICAGO RAILWAY EQUIPMENT COMPANY, CHICAGO, ILL.
CHICAGO RAWHIDE MANUFACTURING COMPANY . . . . . CHICAGO, ILL.
CHIKSAN COMPANY . . . . . BREA, CALIF.
CHIPMAN KNITTING MILLS . . . . EASTON, PA.
CHRYSLER CORPORATION . . . . DETROIT, MICH.
CHRYSLER MOTOR PARTS CORPORATION, DETROIT, MICH.
CHRYSLER SALES CORPORATION . . DETROIT, MICH.
CINCINNATI MILLING MACHINE COMPANY . . . . . CINCINNATI, OHIO
CITIZENS MORTGAGE CORPORATION . DETROIT, MICH.
CLARK CABLE CORPORATION . . CLEVELAND, OHIO
CLARK EQUIPMENT COMPANY . . BUCHANAN, MICH.
CLARK GRAVE VAULT COMPANY . . COLUMBUS, OHIO
CLARK MANUFACTURING COMPANY, J. L., ROCKFORD, ILL.
CLARY MULTIPLIER CORPORATION, SAN GABRIEL, CALIF.
CLAYTON MANUFACTURING COMPANY, EL MONTE, CALIF.
CLEARING MACHINE CORPORATION . CHICAGO, ILL.
CLEVELAND CONTAINER COMPANY . CLEVELAND, OHIC
CLEVELAND GRAPHITE BRONZE COMPANY . . . . . CLEVELAND, OHIO
CLEVELAND HARDWARE & FORGING COMPANY . . . . . CLEVELAND, OHIO
CLEVELAND HOBBING MACHINE COMPANY, EUCLID, OHIO
CLEVELAND PNEUMATIC TOOL COMPANY . . . . . CLEVELAND, OHIO
CLEVELAND STEEL BARREL COMPANY CLEVELAND, OHIO
CLEVELAND TWIST DRILL COMPANY CLEVELAND, OHIO
CLEVELAND WELDING COMPANY . CLEVELAND, OHIO
CLIFFORD MANUFACTURING COMPANY, DIVISION OF STANDARD-THOMSON CORPORATION . . . . . WALTHAM, MASS.
CLIMAX MOLYBDENUM COMPANY . . NEW YORK, N.Y.
CLINE ELECTRIC MANUFACTURING COMPANY . . . . . CHICAGO, ILL.
CLOVER MANUFACTURING COMPANY NORWALK, CONN.
COBUSCO STEEL PRODUCTS . . . DENVER, COLO.
COCA-COLA COMPANY . . . . . ATLANTA, GA.
COLD METAL PRODUCTS COMPANY YOUNGSTOWN, OHIO

Honor Roll of Industrial Preparedness

COLE LABORATORIES, INC. . LONG ISLAND CITY, N.Y.
COLLINS RADIO COMPANY . . . CEDAR RAPIDS, IOWA
COLONIAL BROACH COMPANY . . . DETROIT, MICH.
COLORADO FUEL & IRON CORPORATION DENVER, COLO.
COLSON CORPORATION . . . . ELYRIA, OHIO
COLT'S MANUFACTURING COMPANY HARTFORD, CONN.
COLUMBUS BOLT & FORGING CO. . . COLUMBUS, OHIO
COMMERCIAL BARGE LINES, INC. . . DETROIT, MICH.
COMMERCIAL CARRIERS, INC. . . . DETROIT, MICH.
COMMERCIAL STEEL TREATING CORP. . DETROIT, MICH.
CONE AUTOMATIC MACHINE COMPANY . WINDSOR, VT.
CONMAR PRODUCTS CORPORATION . NEWARK, N.J.
CONSOLIDATED ENGINEERING CORPORATION . . . . . PASADENA, CALIF.
CONSOLIDATED IRON-STEEL MANUFACTURING COMPANY . . . . . CLEVELAND, OHIO
CONSOLIDATED NATURAL GAS COMPANY, NEW YORK, N.Y.
CONSOLIDATED VULTEE AIRCRAFT CORPORATION . . . . . SAN DIEGO, CALIF.
CONSOLIDATED WESTERN STEEL DIVISION, UNITED STATES STEEL CORP. LOS ANGELES, CALIF.
CONTAINER CORPORATION OF AMERICA CHICAGO, ILL.
CONTINENTAL AVIATION & ENGINEERING CORPORATION . . . . . DETROIT, MICH.
CONTINENTAL CAN COMPANY . . . NEW YORK, N.Y.
CONTINENTAL FOUNDRY AND MACHINE COMPANY . . . . . EAST CHICAGO, IND.
CONTINENTAL MOTORS CORPORATION DETROIT, MICH.
CONTINENTAL RUBBER WORKS . . . ERIE, PA.
CONTROL INSTRUMENT COMPANY . . NEW YORK, N.Y.
COOK PAINT & VARNISH COMPANY . DETROIT, MICH.
COPPERWELD STEEL COMPANY . . WARREN, OHIO
CORNING GLASS WORKS . . . . CORNING, N.Y.
CORO, INC. . . . . PROVIDENCE, R.I.
COSA CORPORATION . . . . . NEW YORK, N.Y.
COUCH COMPANY, S. H. . . NORTH QUINCY, MASS.
CRANE COMPANY . . . . . CHICAGO, ILL.
CRIBBEN AND SEXTON COMPANY . . CHICAGO, ILL.
CRONAME, INC. . . . . CHICAGO, ILL.
CROSLEY DIVISION, AVCO MANUFACTURING CORPORATION . . . . . CINCINNATI, OHIO
CROSLEY MOTORS, INC. . . . CINCINNATI, OHIO
CROSS COMPANY . . . . . DETROIT, MICH.
CROWN CAN COMPANY . . . PHILADELPHIA, PA.
CROWN CORK & SEAL COMPANY . . BALTIMORE, MD.
CURRAN COMPANY, FRANK J. . DOWNERS GROVE, ILL.
CURTISS-WRIGHT CORPORATION . WOOD-RIDGE, N.J.
CUSHMAN MOTOR WORKS . . . . LINCOLN, NEBR.
CUTLER-HAMMER, INC. . . . MILWAUKEE, WIS.

DACO MACHINE AND TOOL COMPANY . NEW YORK, N.Y.
DALTON FOUNDRIES, INC. . . . . WARSAW, IND.
DANLY MACHINE SPECIALTIES, INC. . CHICAGO, ILL.
DARBY PRODUCTS OF STEEL PLATE CORPORATION . . . . . KANSAS CITY, KANS.
DARBYSHIRE STEEL COMPANY . . . EL PASO, TEX.
DARLING VALVE & MANUFACTURING COMPANY . . . . . WILLIAMSPORT, PA.
DAVISON CHEMICAL CORPORATION . BALTIMORE, MD.
DAY & ZIMMERMAN, INC. . . . PHILADELPHIA, PA.
DAYSTROM ELECTRIC CORPORATION, POUGHKEEPSIE, N.Y.
DAYTON MALLEABLE IRON COMPANY . DAYTON, OHIO
DAYTON RUBBER COMPANY . . . DAYTON, OHIO
DAYTON STEEL FOUNDRY COMPANY . DAYTON, OHIO
DAZEY CORPORATION . . . . . ST. LOUIS, MO.
DEARBORN STOVE COMPANY . . . . DALLAS, TEX.
DEERE & COMPANY . . . . . MOLINE, ILL.
DELCO PRODUCTS DIVISION, GMC . . DAYTON, OHIO
DELTA TANK MANUFACTURING COMPANY, INC. . . . . BATON ROUGE, LA.
DENISON ENGINEERING COMPANY . COLUMBUS, OHIO
DEPENDABLE AUTOMATIC SCREW COMPANY . . . . . WATERBURY, CONN.
DERRICK & HOIST COMPANY LONG ISLAND CITY, N.Y.
DE SANNO & SON, INC., A. P. . . PHOENIXVILLE, PA.
DE SOTO MOTOR CORPORATION . . DETROIT, MICH.
DETREX CORPORATION . . . . DETROIT, MICH.
DETROIT ALUMINUM AND BRASS CORP. DETROIT, MICH.
DETROIT AUTOMOTIVE PRODUCTS CORPORATION . . . . . DETROIT, MICH.
DETROIT BALL BEARING COMPANY OF MICHIGAN . . . . . DETROIT, MICH.
DETROIT BRASS & MALLEABLE CO. . DETROIT, MICH.
DETROIT CHEMICAL SPECIALTIES, INC. DETROIT, MICH.
DETROIT DIESEL ENGINE DIVISION, GMC DETROIT, MICH.
DETROIT EDISON COMPANY . . . DETROIT, MICH.
DETROIT GASKET & MANUFACTURING COMPANY . . . . . DETROIT, MICH.
DETROIT GEAR DIVISION, BORG-WARNER CORPORATION . . . . . DETROIT, MICH.
DETROIT HARVESTER COMPANY . . DETROIT, MICH.
DETROIT CONTROLS CORPORATION . DETROIT, MICH.
DETROIT-MICHIGAN STOVE COMPANY . DETROIT, MICH.
DETROIT PLATING INDUSTRIES . . DETROIT, MICH.
DETROIT STAMPING COMPANY . . . DETROIT, MICH.
DETROIT STEEL CORPORATION . . DETROIT, MICH.
DETROIT STEEL PRODUCTS COMPANY . DETROIT, MICH.
DETROIT TRANSMISSION DIVISION, GMC DETROIT, MICH.
DEVILBISS COMPANY . . . . . TOLEDO, OHIO
DEVLIEG MACHINE COMPANY . . . FERNDALE, MICH.
DEXTER COMPANY . . . . . FAIRFIELD, IOWA
DIAMOND MATCH COMPANY . . . NEW YORK, N.Y.
DIAMOND T MOTOR CAR COMPANY . CHICAGO, ILL.
DICK COMPANY, A. B. . . . . CHICAGO, ILL.
DICKEY & SONS, INC., W. J. . . . . OELLA, MD.
DIESEL EQUIPMENT DIVISION, GMC, GRAND RAPIDS, MICH.
DISSTON & SONS, INC., HENRY . PHILADELPHIA, PA.
DIVCO CORPORATION . . . . . DETROIT, MICH.
DOALL COMPANY . . . . . DES PLAINES, ILL.
DOCKENDORFF AND COMPANY, INC., BRIDGEPORT, CONN.
DODGE BROTHERS CORPORATION . . DETROIT, MICH.
DOELCAM CORPORATION . . . . NEWTON, MASS.
DOERR ELECTRIC CORPORATION . . CEDARBURG, WIS.
DOUGLAS AIRCRAFT COMPANY SANTA MONICA, CALIF.
DOUGLAS & LOMASON COMPANY . . DETROIT, MICH.
DOUGLAS TOOL COMPANY . . . . DETROIT, MICH.
DRAPER CORPORATION . . . . HOPEDALE, MASS.
DRAPER MOTORS CORPORATION . CENTERLINE, MICH.
DRAVO CORPORATION . . . . . PITTSBURGH, PA.
DRUGE BROTHERS MANUFACTURING COMPANY . . . . . OAKLAND, CALIF.
DUAL-MOTORS CORPORATION . . . DETROIT, MICH.
DUNCAN ELECTRIC MANUFACTURING COMPANY . . . . . LAFAYETTE, IND.

Honor Roll of Industrial Preparedness

DUNHAM COMPANY, C. A. . . . . CHICAGO, ILL.
DU PONT DE NEMOURS & COMPANY, E. I. . . . . WILMINGTON, DEL.
DURHAM MANUFACTURING CORPORATION, MUNCIE, IND.
DURIRON COMPANY . . . . . DAYTON, OHIO

E & L TRANSPORT COMPANY . . DEARBORN, MICH.
EAGLE-PICHER COMPANY . . . CINCINNATI, OHIO
EAGLE TOOL & MACHINE COMPANY SPRINGFIELD, OHIO
EAST COAST AERONAUTICS, INC. . . PELHAM, N.Y.
EASTERN STAINLESS STEEL CORP. . BALTIMORE, MD.
EASTERN TOOL & MANUFACTURING COMPANY . . . . . BELLEVILLE, N.J.
EASTMAN KODAK COMPANY . . . ROCHESTER, N.Y.
EASY WASHING MACHINE CORPORATION, SYRACUSE, N.Y.
EATON MANUFACTURING COMPANY . CLEVELAND, OHIO
EDGEWATER STEEL COMPANY . . . PITTSBURGH, PA.
EDNALITE OPTICAL COMPANY . . . PEEKSKILL, N.Y.
EISEN BROTHERS, INC. . . . . HOBOKEN, N.J.
EKCO PRODUCTS COMPANY . . . CHICAGO, ILL.
ELASTIC STOP NUT CORPORATION OF AMERICA . . . . . UNION, N.J.
ELECTRIC AUTO-LITE COMPANY . . . TOLEDO, OHIO
ELECTRIC FURNACE COMPANY . . . SALEM, OHIO
ELECTRIC SPRAYIT COMPANY . . . SHEBOYGAN, WIS.
ELECTRIC STORAGE BATTERY CO. . PHILADELPHIA, PA.
ELECTRICAL ENGINEERING AND MANUFACTURING CORPORATION . . . . LOS ANGELES, CALIF.
ELECTRICAL REACTANCE CORPORATION . OLEAN, N.Y.
ELECTRO REFRACTORIES & ABRASIVES CORPORATION . . . . . BUFFALO, N.Y.
ELECTRO TEC CORPORATION SOUTH HACKENSACK, N.J.
ELECTROL, INCORPORATED . . . KINGSTON, N.Y.
ELGIN NATIONAL WATCH COMPANY . . ELGIN, ILL.
ELLIOTT COMPANY . . . . . JEANNETTE, PA.
ELLWOOD CITY FORGE COMPANY . ELLWOOD CITY, PA.
EMERSON ELECTRIC MANUFACTURING COMPANY . . . . . ST. LOUIS, MO.
EMERSON RADIO & PHONOGRAPH CORPORATION . . . . . NEW YORK, N.Y.
EMPIRE COIL COMPANY . . . NEW ROCHELLE, N.Y.
EMSCO DERRICK & EQUIPMENT COMPANY . . . . . LOS ANGELES, CALIF.
ENGINEERING RESEARCH INSTITUTE, UNIVERSITY OF MICHIGAN . . . . . ANN ARBOR, MICH.
ENGLANDER COMPANY . . . . CHICAGO, ILL.
ENTERPRISE MACHINE PARTS CORPORATION . . . . . DETROIT, MICH.
ENTERPRISE MANUFACTURING COMPANY AKRON, OHIO
ENTERPRISE TOOL & GEAR CORPORATION, DETROIT, MICH.
ERIE RESISTOR CORPORATION . . . . ERIE, PA.
ESSEX BRASS CORPORATION . . . DETROIT, MICH.
ESSO STANDARD OIL COMPANY . . NEW YORK, N.Y.
EUREKA WILLIAMS CORPORATION BLOOMINGTON, ILL.
EVANS PRODUCTS COMPANY . . PLYMOUTH, MICH.
EVANS' SONS, INC., JOHN . . . PHILADELPHIA, PA.
EX-CELL-O CORPORATION . . . . DETROIT, MICH.
EXACT WEIGHT SCALE COMPANY . . COLUMBUS, OHIO

FABRICON PRODUCTS, INC. . . RIVER ROUGE, MICH.
FACS PRODUCTS, INC. . . . . CHICAGO, ILL.
FAFNIR BEARING COMPANY . NEW BRITAIN, CONN.
FAIRBANKS COMPANY . . . . NEW YORK, N.Y.
FAIRCHILD ENGINE & AIRPLANE CORPORATION . . . . . FARMINGDALE, N.Y.
FALK CORPORATION . . . . MILWAUKEE, WIS.
FALSTROM COMPANY . . . . . PASSAIC, N.J.
FANSTEEL METALLURGICAL CORPORATION . . . . NORTH CHICAGO, ILL.
FARBER, INC., S. W. . . . . NEW YORK, N.Y.
FARGO MOTOR CORPORATION . . . DETROIT, MICH.
FARQUHAR COMPANY, A. B. . . . . YORK, PA.
FARRAND OPTICAL COMPANY . . . NEW YORK, N.Y.
FARREL-BIRMINGHAM COMPANY . . ANSONIA, CONN.
FASCO INDUSTRIES, INC. . . . . ROCHESTER, N.Y.
FAYSCOTT CORPORATION . . . . DEXTER, MAINE
FEDDERS-QUIGAN CORPORATION . . BUFFALO, N.Y.
FEDERAL DROP FORGE COMPANY . . LANSING, MICH.
FEDERAL ELECTRIC PRODUCTS COMPANY . NEWARK, N.J.
FEDERAL LABORATORIES, INC. . SALTSBURG, PA.
FEDERAL-MOGUL CORPORATION . . DETROIT, MICH.
FEDERAL MOTOR TRUCK COMPANY . DETROIT, MICH.
FEDERAL SCREW WORKS . . . . DETROIT, MICH.
FEDERAL TELEPHONE AND RADIO COMPANY . . . . . CLIFTON, N.J.
FELLOWS GEAR SHAPER COMPANY . SPRINGFIELD, VT.
FELT AND TARRANT MANUFACTURING CO., CHICAGO, ILL.
FERRACUTE MACHINE COMPANY . . BRIDGETON, N.J.
FERRO MACHINE & FOUNDRY, INC. . CLEVELAND, OHIO
FERRO STAMPING AND MANUFACTURING COMPANY . . . . . DETROIT, MICH.
FIDELITY-PHILADELPHIA TRUST CO., PHILADELPHIA, PA.
FIFTH THIRD UNION TRUST COMPANY . . . . . CINCINNATI, OHIO
FILER & STOWELL COMPANY . . MILWAUKEE, WIS.
FIRESTONE TIRE & RUBBER COMPANY . AKRON, OHIO
FIRST FEDERAL SAVINGS & LOAN ASSOCIATION OF DETROIT . . . . . DETROIT, MICH.
FIRTH STERLING INC. . . . . PITTSBURGH, PA.
FISHER-PRICE TOYS, INC. . . . EAST AURORA, N.Y.
FITZGIBBONS BOILER COMPANY . . NEW YORK, N.Y.
FITZSIMONS MANUFACTURING COMPANY, DETROIT, MICH.
FLANNERY MANUFACTURING COMPANY, BRIDGEVILLE, PA.
FLOUR CITY ORNAMENTAL IRON COMPANY . . . . . MINNEAPOLIS, MINN.
FLYNN MANUFACTURING COMPANY, MICHAEL . . . . . PHILADELPHIA, PA.
FOLLANSBEE STEEL CORPORATION . PITTSBURGH, PA.
FORD INSTRUMENT COMPANY, DIVISION OF SPERRY CORPORATION . . LONG ISLAND CITY, N.Y.
FORD MOTOR COMPANY . . . . . CHESTER, PA.
FORD MOTOR COMPANY . . . DEARBORN, MICH.
FORMSPRAG COMPANY . . . . . VAN DYKE, MICH.
FORT PITT MALLEABLE IRON DIVISION, STEEL TRADING CORPORATION . . . PITTSBURGH, PA.
FOSTER WHEELER CORPORATION . . NEW YORK, N.Y.
FOUR WHEEL DRIVE AUTO COMPANY, CLINTONVILLE, WIS.
FRAM CORPORATION . . . . PROVIDENCE, R.I.
FRANTZ COMPANY, S. G. . . . . TRENTON, N.J.
FRICK-GALLAGHER MFG. COMPANY . WELLSTON, OHIO
FRIGIDAIRE DIVISION, GMC . . . DAYTON, OHIO
FRUEHAUF TRAILER COMPANY . . DETROIT, MICH.
FULLER BRUSH COMPANY . . . HARTFORD, CONN.
FULLER MANUFACTURING COMPANY, KALAMAZOO, MICH.

Honor Roll of Industrial Preparedness

GAGE PRODUCTS COMPANY . . FERNDALE, MICH.
GAIR COMPANY, ROBERT . . . . NEW YORK, N.Y.
GALION ALLSTEEL BODY DIVISION, CENTRAL OHIO STEEL PRODUCTS COMPANY . . GALION, OHIO
GAR WOOD INDUSTRIES, INC. . . . WAYNE, MICH.
GARLAND MANUFACTURING COMPANY DETROIT, MICH.
GARRETT COMPANY, GEORGE K. . PHILADELPHIA, PA.
GATES RUBBER COMPANY . . . . DENVER, COLO.
GAYCHROME COMPANY . . . WORCESTER, MASS.
GAZDA ENGINEERING . . . . PROVIDENCE, R.I.
GEAR GRINDING MACHINE COMPANY . DETROIT, MICH.
GEMMER MANUFACTURING COMPANY . DETROIT, MICH.
GENERAL AMERICAN TRANSPORTATION CORPORATION . . . . . CHICAGO, ILL.
GENERAL ANILINE & FILM CORPORATION . . . . . NEW YORK, N.Y.
GENERAL AVIATION CORPORATION . NEW YORK, N.Y.
GENERAL CONTROLS COMPANY . GLENDALE, CALIF.
GENERAL DYNAMICS CORPORATION . NEW YORK, N.Y.
GENERAL ELECTRIC COMPANY . . SCHENECTADY, N.Y.
GENERAL FIREPROOFING COMPANY, YOUNGSTOWN, OHIO
GENERAL MALLEABLE CORPORATION WAUKESHA, WIS.
GENERAL METALFAB COMPANY . . . DALLAS, TEX.
GENERAL METALS CORPORATION, SAN FRANCISCO, CALIF.
GENERAL MOTORS CORPORATION . . DETROIT, MICH.
GENERAL MOTORS TRUCK & COACH DIV., GMC . . . . . PONTIAC, MICH.
GENERAL RAILWAY SIGNAL COMPANY ROCHESTER, N.Y.
GENERAL STEEL CASTINGS CORP. . GRANITE CITY, ILL.
GENERAL STEEL PRODUCTS CORPORATION, FLUSHING, N.Y.
GENERAL TEXTILE MILLS, INC. . . NEW YORK, N.Y.
GENERAL TIME CORPORATION . . . NEW YORK, N.Y.
GENERAL TIRE & RUBBER COMPANY . . AKRON, OHIO
GENEVA MODERN KITCHENS . . . . GENEVA, ILL.
GENISCO, INCORPORATED . . LOS ANGELES, CALIF.
GERITY-MICHIGAN CORPORATION . . ADRIAN, MICH.
GEROTOR MAY CORPORATION . . . BALTIMORE, MD.
GERSTENSLAGER COMPANY . . . WOOSTER, OHIO
GEUDER, PAESCHKE & FREY COMPANY, MILWAUKEE, WIS.
GIANNINI & COMPANY, G. M. . . PASADENA, CALIF.
GIBBS MANUFACTURING & RESEARCH CORPORATION . . . . . JANESVILLE, WIS.
GIBSON REFRIGERATOR COMPANY . GREENVILLE, MICH.
GIDDINGS & LEWIS MACHINE TOOL COMPANY . . . . . FOND DU LAC, WIS.
GILBERT & BARKER MANUFACTURING COMPANY . . . . . WEST SPRINGFIELD, MASS.
GISHOLT MACHINE COMPANY . . . MADISON, WIS.
GIVEN MACHINERY COMPANY . . LOS ANGELES, CALIF.
GLEASON WORKS . . . . . ROCHESTER, N.Y.
GLIDDEN COMPANY . . . . . CLEVELAND, OHIO
GLOBE AMERICAN CORPORATION . . KOKOMO, IND.
GLOBE CORPORATION . . . . . CHICAGO, ILL.
GLOBE LIGHTING PRODUCTS, INC. . . BROOKLYN, N.Y.
GLOBE-UNION, INC. . . . . MILWAUKEE, WIS.
G. M. CO MANUFACTURING, INC., LONG ISLAND CITY, N.Y.
GOODRICH COMPANY, B. F. . . . . AKRON, OHIO
GOOD ROADS MACHINERY CORPORATION, MINERVA, OHIO
GOODYEAR TIRE & RUBBER COMPANY . AKRON, OHIO
GORHAM MANUFACTURING COMPANY PROVIDENCE, R.I.
GORTON MACHINE COMPANY, GEO. . . RACINE, WIS.
GOSS PRINTING PRESS COMPANY . . CHICAGO, ILL.
GOULD-NATIONAL BATTERIES, INC. . ST. PAUL, MINN.
GRABLER MANUFACTURING CO. . CLEVELAND, OHIO
GRAFLEX, INC. . . . . ROCHESTER, N.Y.
GRAMMES AND SONS, INC., L. F. . . ALLENTOWN, PA.
GRAND RAPIDS BRASS COMPANY GRAND RAPIDS, MICH.
GRANITE CITY STEEL COMPANY . GRANITE CITY, ILL.
GRAY MARINE MOTOR COMPANY . . DETROIT, MICH.
GREAT LAKES SPRING DIV., STANDARD STEEL SPRING CO. . . . . CHICAGO, ILL.
GREAT LAKES STEEL CORPORATION . DETROIT, MICH.
GREENFIELD TAP AND DIE CORPORATION . . . . . GREENFIELD, MASS.
GREENVILLE STEEL CAR COMPANY . GREENVILLE, PA.
GREER COMPANY, J. W. . . . . CAMBRIDGE, MASS.
GREER HYDRAULICS, INC. . . . . BROOKLYN, N.Y.
GREIST MANUFACTURING COMPANY, NEW HAVEN, CONN.
GROOV-PIN CORPORATION . . . . UNION CITY, N.J.
GRUEN WATCH COMPANY . . . CINCINNATI, OHIO
GUARANTEE SPECIALTY MANUFACTURING COMPANY . . . . . CLEVELAND, OHIO
GULF OIL CORPORATION . . . . PITTSBURGH, PA.
GURLEY, W. & L. E. . . . . TROY, N.Y.

HAGAN CORPORATION . . . . . PITTSBURGH, PA.
HALLETT MANUFACTURING COMPANY . . . . . INGLEWOOD, CALIF.
HALOID COMPANY . . . . . ROCHESTER, N.Y.
HAMILTON FOUNDRY & MACHINE COMPANY . . . . . HAMILTON, OHIO
HAMILTON MANUFACTURING CORPORATION . . . . . COLUMBUS, IND.
HAMILTON WATCH COMPANY . . . LANCASTER, PA.
HANCOCK MANUFACTURING COMPANY JACKSON, MICH.
HANDY & HARMAN . . . . . NEW YORK, N.Y.
HANNIFIN CORPORATION . . . . CHICAGO, ILL.
HANSON-VAN WINKLE-MUNNING COMPANY . . . . . MATAWAN, N.J.
HARDY MANUFACTURING CORPORATION . . . . . PENDLETON, IND.
HARNISCHFEGER CORPORATION . MILWAUKEE, WIS.
HARRINGTON & RICHARDSON ARMS COMPANY . . . . . WORCESTER, MASS.
HARRIS FOUNDRY & MACHINE COMPANY CORDELE, GA.
HARRIS-SEYBOLD COMPANY . . CLEVELAND, OHIO
HARRISBURG STEEL CORPORATION HARRISBURG, PA.
HARSHAW CHEMICAL COMPANY . CLEVELAND, OHIO
HART & COOLEY MANUFACTURING COMPANY . . . . . HOLLAND, MICH.
HARVEY MACHINE COMPANY . . TORRANCE, CALIF.
HAYS MANUFACTURING COMPANY . . . ERIE, PA.
HECKETHORN MANUFACTURING & SUPPLY COMPANY . . . . . LITTLETON, COLO.
HEIL COMPANY . . . . . MILWAUKEE, WIS.
HEINEMANN ELECTRIC COMPANY . . TRENTON, N.J.
HEINTZ MANUFACTURING COMPANY, PHILADELPHIA, PA.
HELI-COIL CORPORATION . . . DANBURY, CONN.
HELTZEL STEEL FORM & IRON COMPANY, WARREN, OHIO
HENDEY MACHINE COMPANY . . TORRINGTON, CONN.
HENDRICK MANUFACTURING COMPANY, CARBONDALE, PA.
HENRY & WRIGHT DIV., EMHART MANUFACTURING COMPANY . . . . . HARTFORD, CONN.
HEPPENSTALL COMPANY . . . . PITTSBURGH, PA.

Honor Roll of Industrial Preparedness

HERCULES MOTORS CORPORATION . CANTON, OHIO
HERCULES POWDER COMPANY . WILMINGTON, DEL.
HERKIMER TOOL AND MODEL WORKS, INC. . . . . HERKIMER, N.Y.
HESSE-EASTERN CORPORATION . CAMBRIDGE, MASS.
HEYDEN CHEMICAL CORPORATION . NEW YORK, N.Y.
HEYL & PATTERSON, INC. . . . . PITTSBURGH, PA.
HEYWOOD WAKEFIELD COMPANY . . GARDNER, MASS.
HICKS & SON COMPANY, S. D. . . . BOSTON, MASS.
HIGGINS, INC. . . . . NEW ORLEANS, LA.
HIGH SPEED HAMMER COMPANY . . ROCHESTER, N.Y.
HIGH STANDARD MANUFACTURING CORPORATION . . . . . HAMDEN, CONN.
HIGHWAY TRAILER COMPANY . . . EDGERTON, WIS.
HILL-CHASE STEEL COMPANY OF MARYLAND . . . . . BALTIMORE, MD.
HILLER HELICOPTERS . . . . PALO ALTO, CALIF.
HOBART BROTHERS COMPANY . . . . TROY, OHIO
HOBART MANUFACTURING COMPANY . . TROY, OHIO
HOE & CO., INC., R. . . . . NEW YORK, N.Y.
HOFMANN & COMPANY, ALFRED WEST NEW YORK, N.J.
HOLDEN COMPANY, A. F. . . . . DETROIT, MICH.
HOLLAND HITCH COMPANY . . . HOLLAND, MICH.
HOLLINGSHEAD CORPORATION, R. M. . . CAMDEN, N.J.
HOLLOW BORING CORPORATION . WORCESTER, MASS.
HOMAN & COMPANY . . . . CINCINNATI, OHIO
HOOSIER TARPAULIN & CANVAS GOODS COMPANY . . . . . INDIANAPOLIS, IND.
HOOVER COMPANY . . . . NORTH CANTON, OHIO
HORROCKS-IBBOTSON COMPANY . . . UTICA, N.Y.
HOTPOINT CO. . . . . CHICAGO, ILL.
HOUDAILLE-HERSHEY CORPORATION . DETROIT, MICH.
HOUGH COMPANY, FRANK G. . . LIBERTYVILLE, ILL.
HOUGHTON & COMPANY, E. F. . PHILADELPHIA, PA.
HOWELL COMPANY . . . . . ST. CHARLES, ILL.
HUBENY BROTHERS, INC. . . . . ROSELLE, N.J.
HUDSON COMPANY, J. L. . . . . DETROIT, MICH.
HUDSON MOTOR CAR COMPANY . . DETROIT, MICH.
HUDSON SHARP MACHINE COMPANY . GREEN BAY, WIS.
HUGHES AIRCRAFT COMPANY DIVISION, HUGHES TOOL COMPANY . . . . . CULVER CITY, CALIF.
HUGHES-KEENAN CORPORATION . DELAWARE, OHIO
HUGHES TOOL COMPANY . . . . HOUSTON, TEX.
HUNTER DOUGLAS CORPORATION . RIVERSIDE, CALIF.
HUNTER SPRING COMPANY . . . LANSDALE, PA.
HUPP CORPORATION . . . . CLEVELAND, OHIO
HURD LOCK & MANUFACTURING CO. . DETROIT, MICH.
HUSSEY & COMPANY, C. G., DIVISION OF COPPER RANGE COMPANY . . . PITTSBURGH, PA.
HUSSMANN REFRIGERATOR COMPANY ST. LOUIS, MO.
HYATT BEARINGS DIVISION, GMC . . HARRISON, N.J.
HYCON MANUFACTURING COMPANY PASADENA, CALIF.
HYDRAULIC PRESS MANUFACTURING COMPANY . . . . . MOUNT GILEAD, OHIO
HYDROPRESS, INC. . . . . NEW YORK, N.Y.

IDEAL INDUSTRIES, INC. . . . . SYCAMORE, ILL.
IDEAL ROLLER & MANUFACTURING CO. CHICAGO, ILL.
ILLINOIS GEAR & MACHINE COMPANY CHICAGO, ILL.
ILLINOIS WATCH CASE COMPANY . . . ELGIN, ILL.
INDEPENDENT LOCK COMPANY . FITCHBURG, MASS.
INDIANA GEAR WORKS, INC. . . INDIANAPOLIS, IND.
INDUSTRIAL FILTER & PUMP MANUFACTURING COMPANY . . . . . CHICAGO, ILL.
INDUSTRIAL GEAR MANUFACTURING COMPANY . . . . . CHICAGO, ILL.
INDUSTRIAL WIRE CLOTH PRODUCTS CORPORATION . . . . . WAYNE, MICH.
INGALLS IRON WORKS COMPANY BIRMINGHAM, ALA.
INLAND MANUFACTURING DIV., GMC . CHICAGO, ILL.
INLAND STEEL COMPANY . . . . CHICAGO, ILL.
INLAND STEEL PRODUCTS COMPANY MILWAUKEE, WIS.
INMAN MANUFACTURING COMPANY . AMSTERDAM, N.Y.
INTER-COASTAL PAINT CORP. . . EAST ST. LOUIS, ILL.
INTERNATIONAL BUSINESS MACHINES CORPORATION . . . . . NEW YORK, N.Y.
INTERNATIONAL HARVESTER COMPANY CHICAGO, ILL.
INTERNATIONAL NICKEL COMPANY, HUNTINGTON, W.VA.
INTERNATIONAL SILVER COMPANY . MERIDEN, CONN.
INTERNATIONAL SPARE PARTS DIVISION, QUEENSBORO PACKAGING CORPORATION . . . . LONG ISLAND CITY, N.Y.
IONIA MANUFACTURING COMPANY . . IONIA, MICH.
IRWIN AUGER BIT COMPANY . . WILMINGTON, OHIO
ITHACA GUN COMPANY . . . . . ITHACA, N.Y.

JACKES-EVANS MANUFACTURING COMPANY . . . . . ST. LOUIS, MO.
JACKSON AND CHURCH COMPANY . . SAGINAW, MICH.
JACOBS COMPANY, F. L. . . . . DETROIT, MICH.
JANNEY CYLINDER COMPANY . . PHILADELPHIA, PA.
JARVIS ENGINEERING WORKS . . . LANSING, MICH.
JERNBERG FORGINGS COMPANY . . CHICAGO, ILL.
JESSOP STEEL COMPANY . . . WASHINGTON, PA.
JOHNS-MANVILLE SALES CORPORATION, NEW YORK, N.Y.
JOHNSON SERVICE COMPANY . . MILWAUKEE, WIS
JONES & LAMSON MACHINE COMPANY, SPRINGFIELD, VT.
JONES & LAUGHLIN STEEL CORPORATION . . . . . PITTSBURGH, PA.
JOY MANUFACTURING COMPANY . . PITTSBURGH, PA.

KABLE BROTHERS COMPANY . . MOUNT MORRIS, ILL.
KAHN ASSOCIATED ARCHITECTS & ENGINEERS, INC., ALBERT . . . . . DETROIT, MICH.
KAISER COMPANY, HENRY J. . . . OAKLAND, CALIF.
KAISER STEEL CORPORATION . . . OAKLAND, CALIF.
KAY MANUFACTURING CORPORATION BROOKLYN, N.Y.
KAYDON ENGINEERING CORPORATION . . . . . MUSKEGON, MICH.
KEARFOTT COMPANY . . . . LITTLE FALLS, N.J.
KEARNEY & TRECKER CORPORATION WEST ALLIS, WIS.
KELLY-SPRINGFIELD TIRE COMPANY CUMBERLAND, MD.
KELSEY-HAYES WHEEL COMPANY . . DETROIT, MICH.
KENNAMETAL, INC. . . . . LATROBE, PA.
KENNEDY-VAN SAUN MANUFACTURING & ENGINEERING COMPANY . . . DANVILLE, PA.
KENT-MOORE ORGANIZATION, INC. . DETROIT, MICH.
KENWORTH MOTOR TRUCK CORP. . . SEATTLE, WASH.
KEUFFEL & ESSER COMPANY . . . HOBOKEN, N.J.
KEYSTONE MANUFACTURING COMPANY . . . . . BOSTON, MASS.
KIDDE & COMPANY, WALTER . . . BELLEVILLE, N.J.
KILGORE, INC. . . . . WESTERVILLE, OHIO
KING POWDER COMPANY . . . CINCINNATI, OHIO

Honor Roll of Industrial Preparedness

KING-SEELEY CORPORATION . . ANN ARBOR, MICH.
KNAPP-MONARCH COMPANY . . . ST. LOUIS, MO.
KNOX METAL PRODUCTS, INC. . . THOMSON, GA.
KOEHRING COMPANY . . . . MILWAUKEE, WIS.
KOHLER COMPANY . . . . . KOHLER, WIS.
KOPPERS COMPANY . . . . . PITTSBURGH, PA.
KOVEN & BROTHER, INC., L. O. . JERSEY CITY, N.J.
KWIKSET LOCKS, INC. . . . . ANAHEIM, CALIF.
KYSOR HEATER COMPANY . . . . CADILLAC, MICH.

LACLEDE STEEL COMPANY . . . . ST. LOUIS, MO.
LAHER SPRING & TIRE CORPORATION OAKLAND, CALIF.
LAKE CITY MALLEABLE IRON CO. . CLEVELAND, OHIO
LAMSON CORPORATION . . . . SYRACUSE, N.Y.
LANDERS FRARY & CLARK . NEW BRITAIN, CONN.
LANOVA CORPORATION . . LONG ISLAND CITY, N.Y.
LANSDOWNE STEEL & IRON COMPANY. MORTON, PA.
LANSING DROP FORGE COMPANY . . LANSING, MICH.
LAPOINTE MACHINE TOOL COMPANY . HUDSON, MASS.
LEAKE STAMPING COMPANY . . . MONROE, MICH.
LEBANON STEEL FOUNDRY . . . LEBANON, PA.
LE BUS ROTARY TOOL WORKS, INC. . LONGVIEW, TEX.
LEE MOTORS, INC. . . . . TOLEDO, OHIO
LEE TIRE & RUBBER COMPANY OF NEW YORK, INC. . . . CONSHOHOCKEN, PA.
LEECE-NEVILLE COMPANY . . . CLEVELAND, OHIO
LEEDS & NORTHRUP COMPANY . PHILADELPHIA, PA.
LEHIGH FOUNDRIES, INC. . . . . EASTON, PA.
LEMPCO PRODUCTS, INC. . . . . BEDFORD, OHIO
LENKURT ELECTRIC COMPANY, SPECIAL EQUIPMENT DIVISION . . . SAN CARLOS, CALIF.
LENNOX FURNACE COMPANY . . COLUMBUS, OHIO
LIBBEY-OWENS-FORD GLASS COMPANY TOLEDO, OHIO
LIEBERKNECHT, INC., KARL . . . . READING, PA.
LIGGETT SUPPLY & EQUIPMENT COMPANY, INC. . . . . ELKHART, IND.
LIGON BROTHERS . . . . . DETROIT, MICH.
LINCOLN ELECTRIC COMPANY . . CLEVELAND, OHIO
LINCOLN ENGINEERING COMPANY . ST. LOUIS, MO.
LINDBERG STEEL TREATING COMPANY. CHICAGO, ILL.
LINK-BELT COMPANY . . . . . CHICAGO, ILL.
LION MANUFACTURING CORPORATION . CHICAGO, ILL.
LIPE-ROLLWAY CORPORATION . . . SYRACUSE, N.Y.
LITTLE, INC., ARTHUR D. . . . CAMBRIDGE, MASS.
LOCK THREAD CORPORATION . . . DETROIT, MICH.
LOCKHEED AIRCRAFT CORPORATION . BURBANK, CALIF.
LOFTUS ENGINEERING CORPORATION . PITTSBURGH, PA.
LONGREN AIRCRAFT COMPANY . TORRANCE, CALIF.
LORRILLARD COMPANY, P. . . . NEW YORK, N.Y.
LOUISIANA POWER & LIGHT CO. . NEW ORLEANS, LA.
L-R HEAT TREATING COMPANY . . NEWARK, N.J.
LUKENS STEEL COMPANY . . . COATESVILLE, PA.
LUMMUS COMPANY . . . . . NEW YORK, N.Y.
LUX CLOCK MANUFACTURING CO. WATERBURY, CONN.
LYCOMING-SPENCER DIVISION, AVCO MANUFACTURING CORPORATION WILLIAMSPORT, PA.
LYNCHBURG FOUNDRY COMPANY . . LYNCHBURG, VA.
LYON, INCORPORATED . . . . . DETROIT, MICH.

MACK MANUFACTURING CORPORATION NEW YORK, N.Y.
MACK MOLDING COMPANY, INC. . . . WAYNE, N.J.
MACKINTOSH-HEMPHILL COMPANY . PITTSBURGH, PA.
MADISON-KIPP CORPORATION . . . MADISON, WIS.
MAGNAFLUX CORPORATION . . . CHICAGO, ILL.
MAGNETIC METALS COMPANY . . . . CAMDEN, N.J.
MAHON COMPANY, R. C. . . . . DETROIT, MICH.
MAJESTIC MANUFACTURING COMPANY ST. LOUIS, MO.
MALL TOOL COMPANY . . . . . CHICAGO, ILL.
MANSFIELD TIRE & RUBBER COMPANY, MANSFIELD, OHIO
MANUFACTURERS NATIONAL BANK OF DETROIT . . . . . DETROIT, MICH.
MARKEM MACHINE COMPANY . . . KEENE, N.H.
MARLBORO WIRE GOODS COMPANY MARLBORO, MASS.
MARLEY COMPANY, INC. . . . . KANSAS CITY, MO.
MARLIN FIREARMS COMPANY . . NEW HAVEN, CONN.
MARLIN-ROCKWELL CORPORATION JAMESTOWN, N.Y.
MARMON-HERRINGTON COMPANY . INDIANAPOLIS, IND.
MARSHALL STEEL COMPANY . . . LA GRANGE, ILL.
MARTIN COMPANY, GLENN L. . . . BALTIMORE, MD.
MARTIN IRON WORKS . . . . . RENO, NEV.
MARTIN-PARRY CORPORATION . WASHINGTON, D.C.
MASCO SCREW PRODUCTS COMPANY DEARBORN, MICH.
MASLAND & SONS, C. H. . . . . CARLISLE, PA.
MASON & HANGER COMPANY . . . NEW YORK, N.Y.
MASON COMPANY, L. E. . . . . HYDE PARK, MASS.
MASSEY-HARRIS COMPANY . . . . RACINE, WIS.
MASSMAN CONSTRUCTION CO. . . KANSAS CITY, MO.
MASTER BUILDERS COMPANY . . CLEVELAND, OHIO
MATHEWS CONVEYOR COMPANY . ELLWOOD CITY, PA.
MATHESON CHEMICAL CORPORATION . BALTIMORE, MD.
MAXSON CORPORATION, W. L. . . NEW YORK, N.Y.
MAYTAG COMPANY . . . . . NEWTON, IOWA
MCCARTHY-ROOT, INC. . . . . DETROIT, MICH.
MCCONWAY & TORLEY CORPORATION PITTSBURGH, PA.
MCCORD CORPORATION . . . . DETROIT, MICH.
MCDOWELL MANUFACTURING CO. . . PITTSBURGH, PA.
MCGLYNN HAYS INDUSTRIES, INC. . BELLEVILLE, N.J.
MCGRAW ELECTRIC COMPANY . . . CHICAGO, ILL.
MCINERNEY SPRING & WIRE CO. GRAND RAPIDS, MICH.
MCKAY COMPANY . . . . . PITTSBURGH, PA.
MCKIERNAN-TERRY CORPORATION . HARRISON, N.J.
MCKINNEY & SON, INC., JAMES . . ALBANY, N.Y.
MCLOUTH STEEL CORPORATION . . DETROIT, MICH.
MCQUAY-NORRIS MANUFACTURING COMPANY . . . . . ST. LOUIS, MO.
MECHANICAL HANDLING SYSTEMS, INC. DETROIT, MICH.
MEDART COMPANY . . . . . ST. LOUIS, MO.
MELCHOIR, ARMSTRONG, DESSAU COMPANY OF DELAWARE, INC. . . . . RIDGEFIELD, N.J.
MELLING FORGING COMPANY . . . LANSING, MICH.
MERCER TUBE & MANUFACTURING CO. . SHARON, PA.
MERGANTHALER LINOTYPE COMPANY . NEW YORK, N.Y.
MERZ ENGINEERING, INC. . . . INDIANAPOLIS, IND.
MESTA MACHINE COMPANY . . . PITTSBURGH, PA.
METAL AUTO PARTS COMPANY . INDIANAPOLIS, IND.
METAL PRODUCTS CORPORATION . . . MIAMI, FLA.
METAL SPECIALTY COMPANY . . CINCINNATI, OHIO
METALS DISINTEGRATING COMPANY . ELIZABETH, N.J.
METRO TOOL & DIE COMPANY . . . DETROIT, MICH.
METROPOLITAN BODY COMPANY . BRIDGEPORT, CONN.
MEYER MANUFACTURING COMPANY, GEO. J. . . . . CUDAHY, WIS.
MICA INSULATOR COMPANY . . SCHENECTADY, N.Y.
MICHIGAN CONSOLIDATED GAS COMPANY, DETROIT, MICH.

Honor Roll of Industrial Preparedness

MICHIGAN STEEL CASTING COMPANY . DETROIT, MICH.
MICROMATIC HONE CORPORATION . DETROIT, MICH.
MIDVALE COMPANY . . . . PHILADELPHIA, PA.
MID-WEST ABRASIVE COMPANY . . OWOSSO, MICH.
MIDWEST PIPING AND SUPPLY COMPANY ST. LOUIS, MO.
MILCO UNDERGARMENT COMPANY . BLOOMSBURG, PA.
MILLER MANUFACTURING COMPANY . DETROIT, MICH.
MILLER MANUFACTURING COMPANY . RICHMOND, VA.
MILLER PRINTING MACHINERY COMPANY . . . . . PITTSBURGH, PA.
MILSCO MANUFACTURING COMPANY MILWAUKEE, WIS.
MINIATURE PRECISION BEARINGS, INC. . KEENE, N.H.
MINNEAPOLIS & ST. LOUIS RAILWAY COMPANY . . . . . MINNEAPOLIS, MINN.
MINNEAPOLIS-HONEYWELL REGULATOR COMPANY . . . . . MINNEAPOLIS, MINN.
MINNEAPOLIS-MOLINE COMPANY . MINNEAPOLIS, MINN.
MISSION APPLIANCE CORPORATION WHITTIER, CALIF.
MISSISSIPPI RIVER FUEL CORPORATION ST. LOUIS, MO.
MISSISSIPPI VALLEY BARGE LINE COMPANY . . . . . ST. LOUIS, MO.
MODINE MANUFACTURING COMPANY . . RACINE, WIS.
MONARCH ALUMINUM MFG. COMPANY, CLEVELAND, OHIO
MONARCH GOVERNOR COMPANY . . DETROIT, MICH.
MONARCH MARKING SYSTEM COMPANY DAYTON, OHIO
MONARCH RUBBER COMPANY . . . HARTVILLE, OHIO
MONROE AUTO EQUIPMENT COMPANY MONROE, MICH.
MONROE CALCULATING MACHINE COMPANY, ORANGE, N.J.
MONTPELIER MANUFACTURING CO. MONTPELIER, OHIO
MOORE DROP FORGING COMPANY . SPRINGFIELD, MASS.
MOORE ENAMELING & MANUFACTURING COMPANY . . . . . W. LAFAYETTE, OHIO
MOORLANE COMPANY . . . . . TULSA, OKLA.
MOREY MACHINERY COMPANY . . ASTORIA, N.Y.
MORGAN CONSTRUCTION COMPANY WORCESTER, MASS.
MORRISON STEEL PRODUCTS, INC. . BUFFALO, N.Y.
MORSE-SMITH-MORSE COMPANY . WATERTOWN, MASS.
MORTELL COMPANY, J. W. . . . . KANKAKEE, ILL.
MOSLER LOCK COMPANY . . . . COVINGTON, KY.
MOSLER SAFE COMPANY . . . . HAMILTON, OHIO
MOTOR PRODUCTS CORPORATION . . DETROIT, MICH.
MOTOR WHEEL CORPORATION . . . LANSING, MICH.
MOTOROLA, INC. . . . . CHICAGO, ILL.
MOTTER'S SONS, GEO. F. . . . . YORK, PA.
M-R-S MANUFACTURING COMPANY . . FLORA, MISS.
MUELLER BRASS COMPANY . . PORT HURON, MICH.
MULLINS MANUFACTURING CORPORATION SALEM, OHIO
MUNCIE GEAR WORKS, INC. . . . MUNCIE, IND.
MURRAY MANUFACTURING COMPANY, D. J., WAUSAU, WIS.
MURRAY MANUFACTURING CORPORATION . . . . . NEW YORK, N.Y.
MURRAY OHIO MANUFACTURING CO. CLEVELAND, OHIO
MYSTIK ADHESIVE PRODUCTS . . . CHICAGO, ILL.

NAGEL-CHASE MANUFACTURING COMPANY, CHICAGO, ILL.
NARROW FABRIC COMPANY . . . . READING, PA.
NASH ENGINEERING COMPANY . . . . SOUTH NORWALK, CONN.
NASH-KELVINATOR CORPORATION . DETROIT, MICH.
NATIONAL ACME COMPANY . . CLEVELAND, OHIO
NATIONAL AUTOMOTIVE FIBERS, INC. DETROIT, MICH.
NATIONAL BANK OF DETROIT . . . DETROIT, MICH.
NATIONAL BRASS COMPANY . GRAND RAPIDS, MICH.
NATIONAL BROACH & MACHINE CO. . DETROIT, MICH.
NATIONAL CAN CORPORATION . . CHICAGO, ILL.
NATIONAL CASH REGISTER COMPANY . DAYTON, OHIO
NATIONAL ELECTRIC PRODUCTS CORPORATION . . . . . PITTSBURGH, PA.
NATIONAL FIREWORKS ORDNANCE CORPORATION . . . . WEST HANOVER, MASS.
NATIONAL GYPSUM COMPANY . . . BUFFALO, N.Y.
NATIONAL LEAD COMPANY . . . NEW YORK, N.Y.
NATIONAL MACHINE PRODUCTS CO. . DETROIT, MICH.
NATIONAL MACHINERY COMPANY . . . TIFFIN, OHIO
NATIONAL MALLEABLE & STEEL CASTINGS COMPANY . . . . . CLEVELAND, OHIO
NATIONAL PNEUMATIC COMPANY . . BOSTON, MASS.
NATIONAL POWDER COMPANY . . . ELDRED, PA.
NATIONAL PRESTO INDUSTRIES . . EAU CLAIRE, WIS.
NATIONAL RADIATOR COMPANY . JOHNSTOWN, PA.
NATIONAL REJECTORS, INC. . . . ST. LOUIS, MO.
NATIONAL RESEARCH CORPORATION CAMBRIDGE, MASS.
NATIONAL ROLL & FOUNDRY COMPANY AVONMORE, PA.
NATIONAL SCREW & MANUFACTURING COMPANY . . . . . CLEVELAND, OHIO
NATIONAL SUPPLY COMPANY . . . PITTSBURGH, PA.
NATIONAL TOOL SALVAGE COMPANY . DETROIT, MICH.
NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION . . . . PITTSBURGH, PA.
NATIONAL VENDORS, INC. . . . . ST. LOUIS, MO.
NEAPCO PRODUCTS, INC. . . . . POTTSTOWN, PA.
NESCO, INC. . . . . MILWAUKEE, WIS.
NEVILLE CHEMICAL COMPANY . . PITTSBURGH, PA.
NEW BRITAIN MACHINE COMPANY, NEW BRITAIN, CONN.
NEW DEPARTURE DIVISION, GMC . . BRISTOL, CONN.
NEW ENGLAND BRASS COMPANY . . TAUNTON, MASS.
NEW ENGLAND PRESSED STEEL COMPANY, NATICK, MASS.
NEW HAMPSHIRE BALL BEARINGS, INC. . . . . PETERBOROUGH, N.H.
NEW HAVEN CLOCK AND WATCH CO., NEW HAVEN, CONN.
NEW PROCESS GEAR CORPORATION . SYRACUSE, N.Y.
NEW YORK AIR BRAKE COMPANY . . NEW YORK, N.Y.
NEWARK STOVE COMPANY . . . NEWARK, OHIO
NEWMAN MACHINE COMPANY . . GREENSBORO, N.C.
NEWTON-NEW HAVEN COMPANY . WEST HAVEN, CONN.
NIAGARA BLOWER COMPANY . . . NEW YORK, N.Y.
NORDBERG MANUFACTURING CO. . MILWAUKEE, WIS.
NORMA-HOFFMANN BEARINGS CORP. STAMFORD, CONN.
NORQUIST PRODUCTS, INC. . . JAMESTOWN, N.Y.
NORRIS, MANUFACTURER, INC., W. C. . TULSA, OKLA.
NORRIS-THERMADOR CORPORATION, LOS ANGELES, CALIF.
NORTH AMERICAN AVIATION . LOS ANGELES, CALIF.
NORTHFIELD FOUNDRY & MACHINE COMPANY . . . . . NORTHFIELD, MINN.
NORTHROP AIRCRAFT, INC., ANAHEIM DIVISION . . . . . ANAHEIM, CALIF.
NORTHWEST AUTOMATIC PRODUCTS CORPORATION . . . . MINNEAPOLIS, MINN.
NORTON COMPANY . . . . . WORCESTER, MASS.

O & S BEARING & MFG. CO. . . . DETROIT, MICH.
OAKITE PRODUCTS, INC. . . . . NEW YORK, N.Y.
OHIO RUBBER COMPANY . . . WILLOUGHBY, OHIO
OHIO STEEL FOUNDRY COMPANY . . . LIMA, OHIO

Honor Roll of Industrial Preparedness

OILGEAR COMPANY . . . . . MILWAUKEE, WIS.
OILJAK MANUFACTURING COMPANY MONTCLAIR, N.J.
O'KEEFE & MERRITT COMPANY LOS ANGELES, CALIF.
OLD TRAIL MOTORS INCORPORATED WASHINGTON, PA.
OLDSMOBILE DIVISION, GMC . . . . LANSING, MICH.
OLIN INDUSTRIES, INC. . . . . EAST ALTON, ILL.
OLIVER CORPORATION . . . . . CHICAGO, ILL.
OLIVER IRON AND STEEL CORPORATION, PITTSBURGH, PA.
OLOFSSON TOOL & DIE COMPANY . . LANSING, MICH.
OLSEN MANUFACTURING COMPANY, SAMUEL . . . . . CHICAGO, ILL.
ONEIDA LTD. . . . . ONEIDA, N.Y.
ONONDAGA POTTERY COMPANY . . SYRACUSE, N.Y.
ONSRUD MACHINE WORKS, INC. . . CHICAGO, ILL.
OPTICAL GAGING PRODUCTS, INC. . . ROCHESTER, N.Y.
ORLEANS MATERIALS & EQUIPMENT COMPANY . . . . . NEW ORLEANS, LA.
OTIS ELEVATOR COMPANY . . . . NEW YORK, N.Y.
OWENS-CORNING FIBERGLAS CORPORATION . . . . . WASHINGTON, D.C.
OWENS-ILLINOIS GLASS COMPANY . TOLEDO, OHIO

PACIFIC CAR AND FOUNDRY COMPANY RENTON, WASH.
PACKARD MOTOR CAR COMPANY . . DETROIT, MICH.
PANTEX MANUFACTURING CORPORATION . . . . . PAWTUCKET, R.I.
PARISH PRESSED STEEL COMPANY . READING, PA.
PARKE THOMPSON ASSOCIATES . . KIRKWOOD, MO.
PARKER PEN COMPANY. . . . . JANESVILLE, WIS.
PARKER RUST PROOF COMPANY . . DETROIT, MICH.
PASS & SEYMOUR, INC.. . . . . SYRACUSE, N.Y.
PATTON MANUFACTURING COMPANY, SPRINGFIELD, OHIO
PECO PLANT, JOHN BEAN DIVISION, FOOD MACHINERY AND CHEMICAL CORPORATION . . . . . PHILADELPHIA, PA.
PEERLESS OF AMERICA, INC. . . . CHICAGO, ILL.
PEMCO CORPORATION . . . . . BALTIMORE, MD.
PENBERTHY INJECTOR COMPANY . . DETROIT, MICH.
PENNSYLVANIA OPTICAL COMPANY . . READING, PA.
PENNSYLVANIA SALT MANUFACTURING COMPANY . . . . . PHILADELPHIA, PA.
PENNSYLVANIA TRANSFORMER CO. CANONSBURG, PA.
PERFEX CORPORATION . . . MILWAUKEE, WIS.
PERMUTIT COMPANY . . . . . NEW YORK, N.Y.
PFIZER & COMPANY, CHARLES . . NEW YORK, N.Y.
PHELPS DODGE COPPER PRODUCTS CORPORATION . . . . . NEW YORK, N.Y.
PHEOLL MANUFACTURING COMPANY . CHICAGO, ILL.
PHILADELPHIA BRONZE & BRASS CORPORATION . . . . . PHILADELPHIA, PA.
PHILCO CORPORATION . . . . . PHILADELPHIA, PA.
PHOENIX BRIDGE COMPANY . . PHOENIXVILLE, PA.
PICKANDS MATHER & COMPANY . CLEVELAND, OHIO
PIERCE GOVERNOR COMPANY, INC. . ANDERSON, IND.
PITNEY-BOWES, INC. . . . . STAMFORD, CONN.
PITTSBURGH CONSOLIDATION COAL COMPANY . . . . . PITTSBURGH, PA.
PITTSBURGH FORGINGS COMPANY . . CORAOPOLIS, PA.
PITTSBURGH PLATE GLASS COMPANY . PITTSBURGH, PA.
PITTSBURGH STEEL FOUNDRY CORPORATION . . . . . PITTSBURGH, PA.
PITTSBURGH TUBE COMPANY . . . PITTSBURGH, PA.
PLUME & ATWOOD MANUFACTURING COMPANY . . . . . WATERBURY, CONN.
PLYMOUTH MOTOR CORPORATION . DETROIT, MICH.
POLORON PRODUCTS, INC. . . . NEW ROCHELLE, N.Y.
PONTIAC MOTOR DIVISION, GMC . . PONTIAC, MICH.
PORCELAIN METALS CORPORATION . LOUISVILLE, KY.
PORTER COMPANY, H. K. . . . . PITTSBURGH, PA.
PORTLAND FORGE & FOUNDRY CO. . PORTLAND, IND.
POTTER & BRUMFIELD MANUFACTURING COMPANY . . . . . PRINCETON, IND.
PRATT & WHITNEY DIVISION, NILES-BEMENT-POND COMPANY . WEST HARTFORD, CONN.
PRECISION CASTINGS COMPANY . . SYRACUSE, N.Y.
PRECISION SPRING CORPORATION . . DETROIT, MICH.
PREFERRED UTILITIES MANUFACTURING CORPORATION . . . . . NEW YORK, N.Y.
PRESSED STEEL CAR COMPANY . . CHICAGO, ILL.
PROCTER & GAMBLE COMPANY . CINCINNATI, OHIO
PROCTOR ELECTRIC COMPANY . . PHILADELPHIA, PA.
PULLMAN-STANDARD CAR MANUFACTURING COMPANY . . . . . CHICAGO, ILL.
PUROLATOR PRODUCTS, INC. . . . RAHWAY, N.J.
PYLE-NATIONAL COMPANY . . . CHICAGO, ILL.

QUEEN PRODUCTS COMPANY . . . LOUISVILLE, KY.

RAILWAY SPECIALTIES CORPORATION . BRISTOL, PA.
RANDALL COMPANY . . . . . CINCINNATI, OHIO
RAY OIL BURNER COMPANY . SAN FRANCISCO, CALIF.
RAYTHEON MANUFACTURING COMPANY . . . . . WALTHAM, MASS.
RCA VICTOR DIVISION, RADIO CORPORATION OF AMERICA . . . . . CAMDEN, N.J.
REACTION MOTORS, INC. . . . . ROCKAWAY, N.J.
READING BATTERIES, INC. . . . . READING, PA.
READING COMPANY . . . . . PHILADELPHIA, PA.
READING TUBE CORPORATION . LONG ISLAND CITY, N.Y.
READY-POWER COMPANY . . . . DETROIT, MICH.
RED ARROW ELECTRONICS CORP. . . BELLEVILLE, N.J.
REEVES INSTRUMENT CORPORATION . NEW YORK, N.Y.
REGINA CORPORATION . . . . . RAHWAY, N.J.
REMINGTON ARMS COMPANY . . BRIDGEPORT, CONN.
REMINGTON RAND INC. . . . . STAMFORD, CONN.
REPUBLIC STEEL CORPORATION . CLEVELAND, OHIO
REVERE COPPER & BRASS, INC. . . NEW YORK, N.Y.
REYNOLDS METALS COMPANY . . . RICHMOND, VA.
REYNOLDS SPRING COMPANY . . . JACKSON, MICH.
RHEEM MANUFACTURING COMPANY . NEW YORK, N.Y.
RICHARDS-WILCOX MANUFACTURING COMPANY . . . . . AURORA, ILL.
RICHFIELD OIL CORPORATION . . LOS ANGELES, CALIF.
RICHMOND ENGINEERING COMPANY . RICHMOND, VA.
RICHMOND SCREW ANCHOR COMPANY NEW YORK, N.Y.
RINSHED-MASON COMPANY . . . DETROIT, MICH.
RITEPOINT COMPANY . . . . . ST. LOUIS, MO.
RIVERSIDE FOUNDRY, INC. . . BETTENDORF, IOWA
RIVERSIDE METAL COMPANY . . . RIVERSIDE, N.J.
ROBBINS TIRE & RUBBER COMPANY . TUSCUMBIA, ALA.
ROBERTSHAW-FULTON CONTROLS COMPANY . . . . . GREENSBURG, PA.
ROCHESTER PRODUCTS DIVISION, GMC, ROCHESTER, N.Y.
ROCKLAND FIREWORKS COMPANY . BOSTON, MASS.
ROCKWELL MANUFACTURING COMPANY, PITTSBURGH, PA.

Honor Roll of Industrial Preparedness

ROCKWELL SPRING AND AXLE COMPANY . . . . . CORAOPOLIS, PA.
ROCKWELL SPRING AND AXLE COMPANY, DETROIT, MICH.
ROCKWOOD SPRINKLER COMPANY WORCESTER, MASS.
RODGERS HYDRAULIC, INC. . MINNEAPOLIS, MINN.
ROHM & HAAS COMPANY . . . PHILADELPHIA, PA.
RONSON ART METAL WORKS, INC. . NEWARK, N.J.
ROPER CORPORATION, GEORGE D. . . ROCKFORD, ILL.
ROSS GEAR AND TOOL COMPANY . LAFAYETTE, IND.
ROSS-MEEHAN FOUNDRIES . CHATTANOOGA, TENN.
ROTARY ELECTRIC STEEL COMPANY . DETROIT, MICH.
ROY, INC., ROSS . . . . . DETROIT, MICH.
ROYAL TYPRWRITER COMPANY . HARTFORD, CONN.
RUDEL MACHINERY COMPANY . . . NEW YORK, N.Y.
RUDISILL FOUNDRY COMPANY . . ANNISTON, ALA.
RULON COMPANY . . . . . CHICAGO, ILL.
RYERSON & HAYNES, INC. . . . . JACKSON, MICH.

S & M LAMP COMPANY . . LOS ANGELES, CALIF.
S & S CORRUGATED PAPER MACHINERY COMPANY . . . . . BROOKLYN, N.Y.
SACO-LOWELL SHOPS . . . . . BOSTON, MASS.
SAE STEELS . . . . . CLEVELAND, OHIO
SAFRAN PRINTING COMPANY . . . DETROIT, MICH.
SAGINAW MALLEABLE IRON DIVISION, GMC . . . . . SAGINAW, MICH.
SAGINAW STEERING GEAR DIVISION, GMC . . . . . SAGINAW, MICH.
ST. CLAIR RUBBER COMPANY . . . DETROIT, MICH.
ST. LOUIS CAR COMPANY . . . . ST. LOUIS, MO.
ST. REGIS PAPER COMPANY . . . NEW YORK, N.Y.
SALEM-BROSIUS, INC. . . . . SALEM, OHIO
SALEM TOOL COMPANY . . . . . SALEM, OHIO
SAMPSEL TIME CONTROL, INC. . SPRING VALLEY, ILL.
SANDERSON & PORTER . . . . NEW YORK, N.Y.
SANDIA CORPORATION . . . ALBUQUERQUE, N.MEX.
SANDPAPER, INC. . . . . ROCKLAND, MASS.
SARGENT & GREENLEAF, INC. . . . ROCHESTER, N.Y.
SAVAGE ARMS CORPORATION . . . . UTICA, N.Y.
SCAIFE COMPANY . . . . . PITTSBURGH, PA.
SCHAIBLE COMPANY . . . . CINCINNATI, OHIO
SCHLAGE LOCK COMPANY . . SAN FRANCISCO, CALIF.
SCHLITZ BREWING COMPANY, JOSEPH, MILWAUKEE, WIS.
SCHLUETER MANUFACTURING COMPANY, ST. LOUIS, MO.
SCHWITZER-CUMMINS COMPANY . INDIANAPOLIS, IND.
SCOVILL MANUFACTURING COMPANY, WATERBURY, CONN.
SCREW PRODUCTS CORPORATION OF AMERICA . . . . . SOUTH GATE, CALIF.
SCULLIN STEEL COMPANY . . . . ST. LOUIS, MO.
SEAMAN MOTORS, INC. . . . MILWAUKEE, WIS.
SEARS, ROEBUCK AND COMPANY . . CHICAGO, ILL.
SEEGER REFRIGERATOR COMPANY . ST. PAUL, MINN.
SEIBERLING RUBBER COMPANY . . . AKRON, OHIO
SELMER, INC., H. & A., JESSE FRENCH & SONS PIANO DIVISION . . . NEW CASTLE, IND.
SERVEL, INC . . . . . EVANSVILLE, IND.
SESSIONS CLOCK COMPANY . . FORESTVILLE, CONN.
SEXTON CAN COMPANY . . . . EVERETT, MASS.
SHAFER BEARING CORPORATION DOWNERS GROVE, ILL.
SHAKEPROOF, INC., DIV., ILLINOIS TOOL WORKS . . . . . ELGIN, ILL.
SHARON STEEL CORPORATION . . . . SHARON, PA.
SHEAFFER PEN COMPANY, W. A. FORT MADISON, IOWA
SHEFFIELD CORPORATION . . . . DAYTON, OHIO
SHEFFIELD STEEL CORPORATION . KANSAS CITY, MO.
SHELL OIL COMPANY . . . . . NEW YORK, N.Y.
SHENANGO AGALOY TUBE COMPANY, SPRINGFIELD, OHIO
SHERWIN-WILLIAMS COMPANY . CLEVELAND, OHIO
SILAS MASON COMPANY . . . SHREVEPORT, LA.
SILENT GLOW OIL BURNER CORP. . HARTFORD, CONN.
SIMMONS COMPANY . . . . . NEW YORK, N.Y.
SIMONDS SAW & STEEL COMPANY . FITCHBURG, MASS.
SIMPLEX TIME RECORDER COMPANY . GARDNER, MASS.
SINGER MANUFACTURING COMPANY, ELIZABETHPORT, N.J.
SIVYER STEEL CASTING COMPANY MILWAUKEE, WIS.
SKF INDUSTRIES, INC. . . . . PHILADELPHIA, PA.
SLACK, INC., A. J. . . . . WORCESTER, MASS.
SLAYMAKER LOCK COMPANY . . . LANCASTER, PA.
SLOSS-SHEFFIELD STEEL & IRON CO. BIRMINGHAM, ALA.
SMITH & CORONA TYPEWRITERS, INC., L. C. . . . . SYRACUSE, N.Y.
SMITH & WESSON, INC. . . . SPRINGFIELD, MASS.
SMITH COMPANY, S. MORGAN . . . . YORK, PA.
SMITH COMPANY, T. L. . . . MILWAUKEE, WIS.
SMITH CORPORATION, A. O. . . MILWAUKEE, WIS.
SMITH, DRUM & COMPANY . . PHILADELPHIA, PA.
SMITH, INC., ALEXANDER . . . . YONKERS, N.Y.
SNYDER MANUFACTURING COMPANY, H. P. . . . . LITTLE FALLS, N.Y.
SNYDER TOOL & ENGINEERING COMPANY, DETROIT, MICH.
SOCONY-VACUUM OIL COMPANY . . DETROIT, MICH.
SOLAR STEEL CORPORATION . . CLEVELAND, OHIO
SORENG MANUFACTURING CORPORATION . . . . SCHILLER PARK, ILL.
SOUTH BEND LATHE WORKS . . SOUTH BEND, IND.
SOUTHERN COACH MANUFACTURING COMPANY . . . . . EVERGREEN, ALA.
SOUTHERN NATURAL GAS COMPANY BIRMINGHAM, ALA.
SOUTHERN STATES EQUIPMENT CORPORATION . . . . . HAMPTON, GA.
SOUTHWEST STONE COMPANY . . . . DALLAS, TEX.
S-P MANUFACTURING CORPORATION CLEVELAND, OHIO
SPALDING & BROS., INC., A. G. . . CHICOPEE, MASS.
SPARKLER MANUFACTURING COMPANY, MUNDELEIN, ILL.
SPECIALTIES, INC. . . . . SYOSSET, N.Y.
SPEED-O-PRINT CORPORATION . . CHICAGO, ILL.
SPEED QUEEN CORPORATION . . . . RIPON, WIS.
SPENCER CHEMICAL COMPANY . KANSAS CITY, MO.
SPERRY CORPORATION . . . . . NEW YORK, N.Y.
SPERRY GYROSCOPE COMPANY . GREAT NECK, N.Y.
SPICER MANUFACTURING DIVISION, DANA CORPORATION . . . . TOLEDO, OHIO
SPRAGUE & CARLETON, INC. . . . . KEENE, N.H.
SPRAGUE ELECTRIC COMPANY . NORTH ADAMS, MASS.
SQUARE D COMPANY . . . . . DETROIT, MICH.
STANDARD ASBESTOS MFG. COMPANY . CHICAGO, ILL.
STANDARD CONTAINER, INC. . . . MONTCLAIR, N.J.
STANDARD FORGINGS CORPORATION . CHICAGO, ILL.
STANDARD GAGE COMPANY . . POUGHKEEPSIE, N.Y.
STANDARD PRODUCTS COMPANY . . DETROIT, MICH.
STANDARD RAILWAY EQUIPMENT MANUFACTURING COMPANY . . CHICAGO, ILL.
STANDARD SERVICE TIRE COMPANY, INC. . . . . SEATTLE, WASH.

Honor Roll of Industrial Preparedness

STANDARD TUBE COMPANY . . . DETROIT, MICH.
STARLINE INCORPORATED . . . . HARVARD, ILL.
STEARNS-ROGERS MANUFACTURING CO. DENVER, COLO.
STEEL CITY ELECTRIC COMPANY . . PITTSBURGH, PA.
STEEL IMPROVEMENT & FORGE CO. CLEVELAND, OHIO
STERLING ENGINE COMPANY . . . BUFFALO, N.Y.
STERLING ENGINEERING COMPANY . NEWARK, N.J.
STEVENS & COMPANY, J. P. . . . NEW YORK, N.Y.
STEWART-WARNER CORPORATION . CHICAGO, ILL.
STILE-CRAFT MANUFACTURERS, INC. . ST. LOUIS, MO.
STOCKHAM VALVES & FITTINGS . BIRMINGHAM, ALA.
STOKES MACHINE COMPANY, F. J. PHILADELPHIA, PA.
STOLLE CORPORATION . . . . CINCINNATI, OHIO
STONE & WEBSTER ENGINEERING CORPORATION . . . . . NEW YORK, N.Y.
STONER MANUFACTURING CORPORATION AURORA, ILL.
STONER-MUDGE, INC. . . . . PITTSBURGH, PA.
STRELINGER COMPANY, CHAS. A. . . DETROIT, MICH.
STROMBERG TIME CORPORATION . . NEW YORK, N.Y.
STRONG STEEL FOUNDRY COMPANY . BUFFALO, N.Y.
STUART OIL COMPANY, D. A. . . . CHICAGO, ILL.
STUDEBAKER CORPORATION . . SOUTH BEND, IND.
SUN ELECTRIC CORPORATION . . . CHICAGO, ILL.
SUN OIL COMPANY . . . . . PHILADELPHIA, PA.
SUPER-VENT COMPANY . . . . CHICAGO, ILL.
SUPERIOR COACH CORPORATION . . . LIMA, OHIO
SUPERIOR SHEET STEEL DIVISION, LOUIS BERKMAN COMPANY . . . CANTON, OHIO
SUPERIOR STEEL CORPORATION . . CARNEGIE, PA.
SUPREME KNITTING MACHINE COMPANY, NEW YORK, N.Y.
SURFACE COMBUSTION CORPORATION . TOLEDO, OHIO
SUTTON CORPORATION, O. A. . . . WICHITA, KANS.
SWAN-FINCH OIL CORPORATION . . NEW YORK, N.Y.
SWANK, INC . . . . . ATTLEBORO, MASS.
SWARD COMPANY, H. A. . . . . INWOOD, N.Y.
SYLVANIA ELECTRIC PRODUCTS, INC. . NEW YORK, N.Y.
SYMINGTON-GOULD CORPORATION . . DEPEW, N.Y.

TABER INSTRUMENT CORPORATION . . . NORTH TONAWANDA, N.Y.
TALON, INC. . . . . MEADVILLE, PA.
TAYLOR & GASKIN, INC. . . . . DETROIT, MICH.
TEINER COMPANY, ROLAND . . . EVERETT, MASS.
TEMCO, INC. . . . . NASHVILLE, TENN.
TENNANT, SONS & COMPANY OF NEW YORK, C. . . . . NEW YORK, N.Y.
TENNESSEE COAL & IRON DIVISION, U. S. STEEL COMPANY . . . . . FAIRFIELD, ALA.
TENNESSEE CORPORATION . . . . NEW YORK, N.Y.
TENNESSEE EASTMAN COMPANY . KINGSPORT, TENN.
TENNEY ENGINEERING, INC. . . . NEWARK, N.J
TERNSTEDT DIVISION, GMC . . . DETROIT, MICH.
TERRELL MACHINE COMPANY . . . CHARLOTTE, N.C.
TEXAS GULF SULPHUR COMPANY . . NEW YORK, N.Y.
TEXAS INSTRUMENTS INCORPORATED . DALLAS, TEX.
TEXTILE MACHINE WORKS . . . READING, PA.
TEXTILEATHER CORPORATION . . TOLEDO, OHIO
THIOKOL CORPORATION . . . . TRENTON, N.J.
THOMAS INDUSTRIES, INC. . FORT ATKINSON, WIS.
THOMPSON PRODUCTS, INC. . . CLEVELAND, OHIO
THOR CORPORATION . . . . . CHICAGO, ILL.
TIMKEN ROLLER BEARING COMPANY . CANTON, OHIO
TIMMS SPRING COMPANY . . . . ELYRIA, OHIO
TITAN METAL MANUFACTURING CO. . BELLEFONT, PA.
TITEFLEX, INC. . . . . NEWARK, N.J.
TOKHEIM OIL TANK AND PUMP CO. FORT WAYNE, IND.
TOWER IRON WORKS . . . . PROVIDENCE, R.I.
TOWNSEND COMPANY . . . . NEW BRIGHTON, PA.
TRACTOMOTIVE CORPORATION . . DEERFIELD, ILL.
TRAILMOBILE, INC. . . . . CINCINNATI, OHIO
TRANSUE & WILLIAMS STEEL FORGING CORPORATION . . . . . ALLIANCE, OHIO
TREADWELL CONSTRUCTION COMPANY MIDLAND, PA.
TREDEGAR COMPANY . . . . . RICHMOND, VA.
TRI-CLOVER MACHINE COMPANY . . KENOSHA, WIS.
TRICO PRODUCTS CORPORATION . . BUFFALO, N.Y.
TRIFARI, KRUSSMAN & FISHEL, INC. PROVIDENCE, R.I.
TRIPLEX CORPORATION OF AMERICA . PUEBLO, COLO.
TROJAN POWDER COMPANY . . . ALLENTOWN, PA.
TUBE REDUCING CORPORATION . WALLINGTON, N.J.
TULSA WINCH DIVISION, VICKERS, INC. TULSA, OKLA.
TURNER BRASS WORKS . . . . SYCAMORE, ILL.
TWIN DISC CLUTCH COMPANY . . . RACINE, WIS.
TYSON BEARING CORPORATION . MASSILLON, OHIO

UDYLITE CORPORATION . . . . DETROIT, MICH.
ULTRASONIC CORPORATION . . CAMBRIDGE, MASS.
UNDERWOOD CORPORATION . . . NEW YORK, N.Y.
UNION BAG & PAPER CORPORATION . NEW YORK, N.Y.
UNION CARBINE AND CARBON CORP. . NEW YORK, N.Y.
UNION METAL MANUFACTURING COMPANY, CANTON, OHIO
UNITED AIRCRAFT CORPORATION, EAST HARTFORD, CONN.
UNITED-CARR FASTENER CORP. . CAMBRIDGE, MASS.
UNITED CHROMIUM, INC. . . . . NEW YORK, N.Y.
UNITED ENGINEERING & FOUNDRY CO., PITTSBURGH, PA.
UNITED METAL BOX COMPANY . . NEW YORK, N.Y.
UNITED MOTORS SERVICE DIVISION, GMC, DETROIT, MICH.
UNITED PLATERS, INC. . . . . DETROIT, MICH.
UNITED SHOE MACHINERY CORPORATION, BOSTON, MASS.
UNITED SPECIALTIES COMPANY . . CHICAGO, ILL.
UNITED STATES AIR CONDITIONING CORPORATION . . . . MINNEAPOLIS, MINN.
UNITED STATES HOFFMAN MACHINERY CORPORATION . . . . . AUBURN, N.Y.
UNITED STATES HOFFMAN MACHINERY CORPORATION . . . . . NEW YORK, N.Y.
U. S. MACHINE CORPORATION . . . LEBANON, IND.
UNITED STATES PIPE AND FOUNDRY COMPANY . . . . . BIRMINGHAM, ALA.
UNITED STATES RUBBER COMPANY . NEW YORK, N.Y.
UNITED STATES SPRING AND BUMPER COMPANY . . . . . LOS ANGELES, CALIF.
UNITED STATES STEEL CORPORATION PITTSBURGH, PA.
UNITED STATES STEEL SUPPLY DIVISION, UNITED STATES STEEL CORPORATION CHICAGO, ILL.
UNITED STATES TIME CORPORATION, WATERBURY, CONN.
UNITED TUBE CORPORATION OF OHIO, CLEVELAND, OHIO
UNIVERSAL BUTTON FASTENING AND BUTTON COMPANY . . . . . DETROIT, MICH.
UNIVERSAL MATCH CORPORATION . ST. LOUIS, MO.
UNIVERSAL OIL PRODUCTS COMPANY, DES PLAINES, ILL.
UNIVERSAL PRODUCTS COMPANY . DEARBORN, MICH.
UNIVERSAL WINDING COMPANY . . CRANSTON, R.I.
UTICA CUTLERY COMPANY . . . . UTICA, N.Y.

Honor Roll of Industrial Preparedness

VANDERCOOK & SONS, INC. . . . CHICAGO, ILL.
VAN DORN IRON WORKS COMPANY CLEVELAND, OHIO
VAN KEUREN COMPANY . . . WATERTOWN, MASS.
VAN NORMAN COMPANY . . . SPRINGFIELD, MASS.
VARD INC. . . . . PASADENA, CALIF.
VASCOLOY-RAMET CORPORATION . . WAUKEGAN, ILL.
VEEDER-ROOT, INC. . . . . HARTFORD, CONN.
VELSICOL CORPORATION . . . . CHICAGO, ILL.
VERSON ALLSTEEL PRESS COMPANY . CHICAGO, ILL.
VICKERS, INC. . . . . DETROIT, MICH.
VICTOR ADDING MACHINE COMPANY . CHICAGO, ILL.
VICTOR MANUFACTURING & GASKET COMPANY . . . . . CHICAGO, ILL.
VICTORY PLASTICS COMPANY . . . HUDSON, MASS.
VIKING TOOL & MACHINE CORPORATION, BELLEVILLE, N.J.
VISKING CORPORATION . . . . CHICAGO, ILL.
VITRO CORPORATION OF AMERICA . NEW YORK, N.Y.
VOLCO BRASS AND COPPER COMPANY, KENILWORTH, N.J.

WADE ELECTRIC PRODUCTS COMPANY STURGIS, MICH.
WAGNER ELECTRIC CORPORATION . ST. LOUIS, MO.
WAGNER MALLEABLE IRON COMPANY DECATUR, ILL.
WALD INDUSTRIES, INC. . . . HUNTINGTON, PA.
WALDES KOHINOOR, INC. . . LONG ISLAND CITY, N.Y.
WALKER MANUFACTURING COMPANY OF WISCONSIN . . . . . RACINE, WIS.
WALTERS MANUFACTURING COMPANY OAKMONT, PA.
WALTHAM SCREW COMPANY . . . WALTHAM, MASS.
WALTHAM WATCH COMPANY . . . WALTHAM, MASS.
WALWORTH COMPANY . . . . . NEW YORK, N.Y.
WARD LAFRANCE TRUCK CORPORATION . ELMIRA, N.Y.
WARE BROTHERS DIVISION, CHICAGO ROLLER SKATE COMPANY . . . . . CHICAGO, ILL.
WARNER & SWASEY COMPANY . CLEVELAND, OHIO
WARNER ELECTRIC BRAKE & CLUTCH CO. BELOIT, WIS.
WARREN BROTHERS ROADS COMPANY, CAMBRIDGE, MASS.
WARREN WEBSTER & COMPANY . . . CAMDEN, N.J.
WATERBURY COMPANIES, INCORPORATED . . . . . WATERBURY, CONN.
WATERBURY FARREL FOUNDRY & MACHINE COMPANY . . . . . WATERBURY, CONN.
WAUKESHA MOTOR COMPANY . . . WAUKESHA, WIS.
WEATHERHEAD COMPANY . . . CLEVELAND, OHIO
WEBB COMPANY, JERVIS B. . . . DETROIT, MICH.
WEBER DENTAL MANUFACTURING COMPANY . . . . . CANTON, OHIO
WEIRTON STEEL COMPANY . . . WEIRTON, W.VA.
WELLMAN COMPANY, S. K. . . . BEDFORD, OHIO
WERNER COMPANY, R. D. . . . . GREENVILLE, PA.
WEST BEND ALUMINUM COMPANY . WEST BEND, WIS.
WEST POINT MANUFACTURING COMPANY, BOSTON, MASS.
WEST TIRE SETTER COMPANY . . . ROCHESTER, N.Y.
WESTERN ARC WELDING, INC. . LOS ANGELES, CALIF.
WESTERN ELECTRIC COMPANY . . NEW YORK, N.Y.
WESTERN FELT WORKS. . . . . CHICAGO, ILL.
WESTERN GEAR WORKS . . . LYNWOOD, CALIF.
WESTINGHOUSE AIR BRAKE COMPANY, WILMERDING, PA.
WESTINGHOUSE ELECTRIC CORPORATION . . . . . PITTSBURGH, PA.
WESTMORELAND METAL MANUFACTURING COMPANY . . . . . PHILADELPHIA, PA.
WHEEL TRUEING TOOL COMPANY . . DETROIT, MICH.
WHEELER CORPORATION, FOSTER . . NEW YORK, N.Y.
WHEELING STEEL CORPORATION . WHEELING, W.VA.
WHEELOCK, LOVEJOY & COMPANY CAMBRIDGE, MASS.
WHELAND COMPANY . . . CHATTANOOGA, TENN.
WHIRLPOOL CORPORATION . . ST. JOSEPH, MICH.
WHITE MOTOR COMPANY . . . CLEVELAND, OHIO
WHITE RODGERS ELECTRIC COMPANY . ST. LOUIS, MO.
WHITEHEAD & KALES COMPANY . RIVER ROUGE, MICH.
WHITEHEAD STAMPING COMPANY . . DETROIT, MICH.
WHITIN MACHINE WORKS . . WHITINSVILLE, MASS.
WHITIN MANUFACTURING COMPANY, PAUL . . . . . NORTHBRIDGE, MASS.
WHITING & DAVIS COMPANY . . PLAINVILLE, MASS.
WHITNEY CHAIN COMPANY . . HARTFORD, CONN.
WICKES BROTHERS DIVISION, WICKES CORPORATION . . . . . SAGINAW, MICH.
WICO ELECTRIC COMPANY . WEST SPRINGFIELD, MASS.
WIEGAND COMPANY, EDWIN L. . . PITTSBURGH, PA.
WILCOX FORGING CORPORATION . MECHANICSBURG, PA.
WILLOUGHBY CHEVROLET COMPANY . RICHMOND, IND.
WILLYS-OVERLAND MOTORS, INC. . TOLEDO, OHIO
WILMINGTON CASTING COMPANY . WILMINGTON, OHIO
WINCHESTER REPEATING ARMS CO., NEW HAVEN, CONN.
WINTER-WEISS COMPANY . . . . DENVER, COLO.
WIPING MATERIALS, INC. . . . . ST. LOUIS, MO.
WISCONSIN MOTOR CORPORATION MILWAUKEE, WIS.
WOLVERINE FABRICATING & MANUFACTURING COMPANY . . . . . INKSTER, MICH.
WOLVERINE TUBE DIVISION, CALUMET & HECLA, INC. . . . DETROIT, MICH.
WOOD COMPANY, JOHN . . CONSHOHOCKEN, PA.
WOOD COMPANY, R. D. . . . PHILADELPHIA, PA.
WOOD-MOSAIC COMPANY . . . . LOUISVILLE, KY.
WORCESTER PRESSED STEEL COMPANY . . . . . WORCESTER, MASS.
WORCESTER TAPER PIN COMPANY WORCESTER, MASS.
WORDEN-ALLEN COMPANY . . MILWAUKEE, WIS.
WRIGHT MACHINE COMPANY . . WORCESTER, MASS.
WROUGHT IRON RANGE COMPANY . ST. LOUIS, MO.
WYANDOTTE CHEMICALS CORPORATION . . . . . WYANDOTTE, MICH.
WYCKOFF STEEL COMPANY . . . PITTSBURGH, PA.
WYSONG & MILES COMPANY . . GREENSBORO, N.C.

YODER COMPANY . . . . . CLEVELAND, OHIO
YORK CORPORATION . . . . . YORK, PA.
YORK-SHIPLEY, INC. . . . . YORK, PA.
YOUNG RADIATOR COMPANY . . . RACINE, WIS.
YOUNG SPRING & WIRE CORPORATION, L. A. . . . . DETROIT, MICH.
YOUNGSTOWN SHEET & TUBE COMPANY . . . . . YOUNGSTOWN, OHIO

ZELLER CORPORATION . . . . . DEFIANCE, OHIO
ZENITE METAL CORPORATION . . INDIANAPOLIS, IND.
ZENITH RADIO CORPORATION . . . CHICAGO, ILL.
ZIM MANUFACTURING COMPANY . . CHICAGO, ILL.